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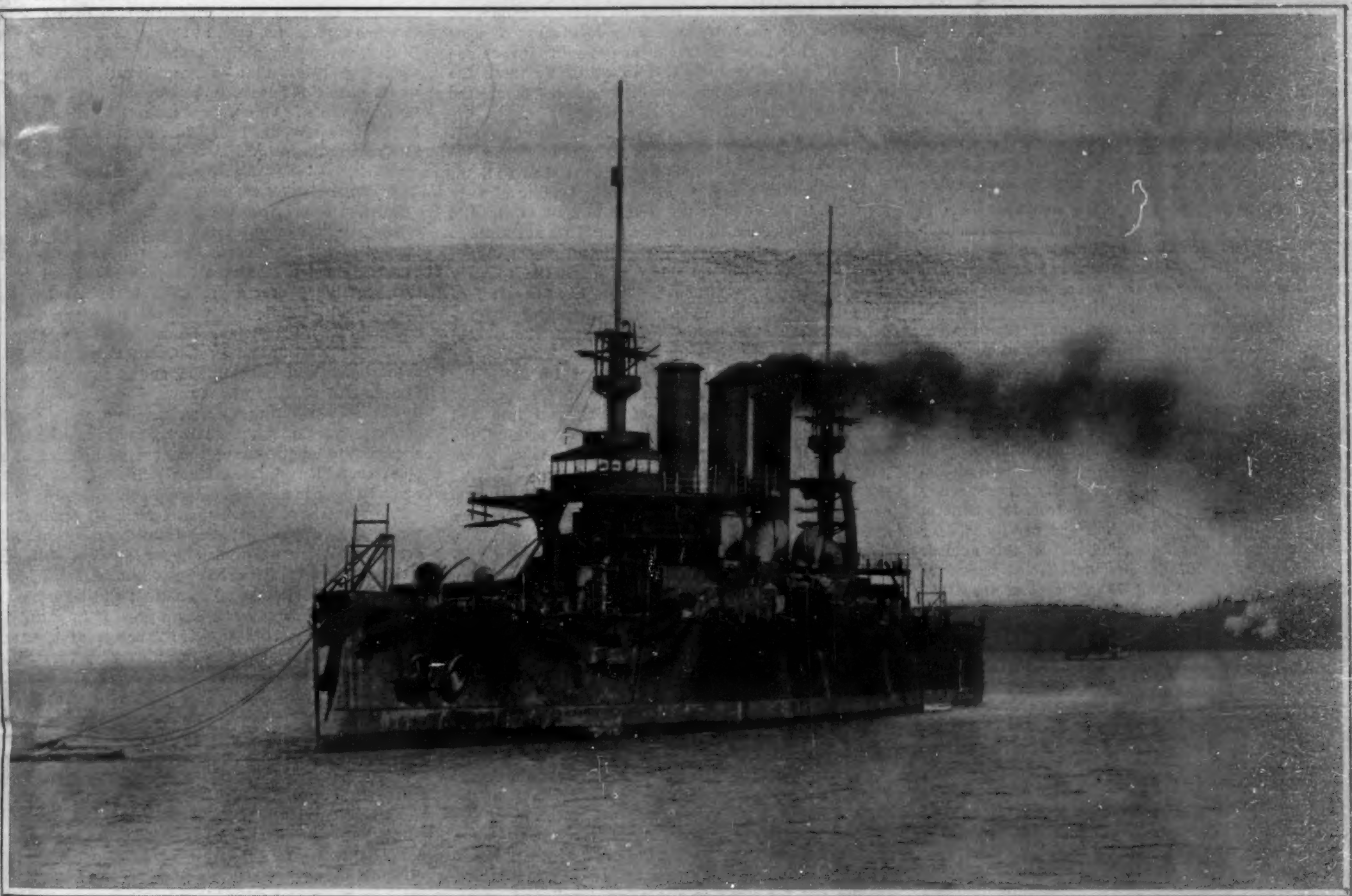
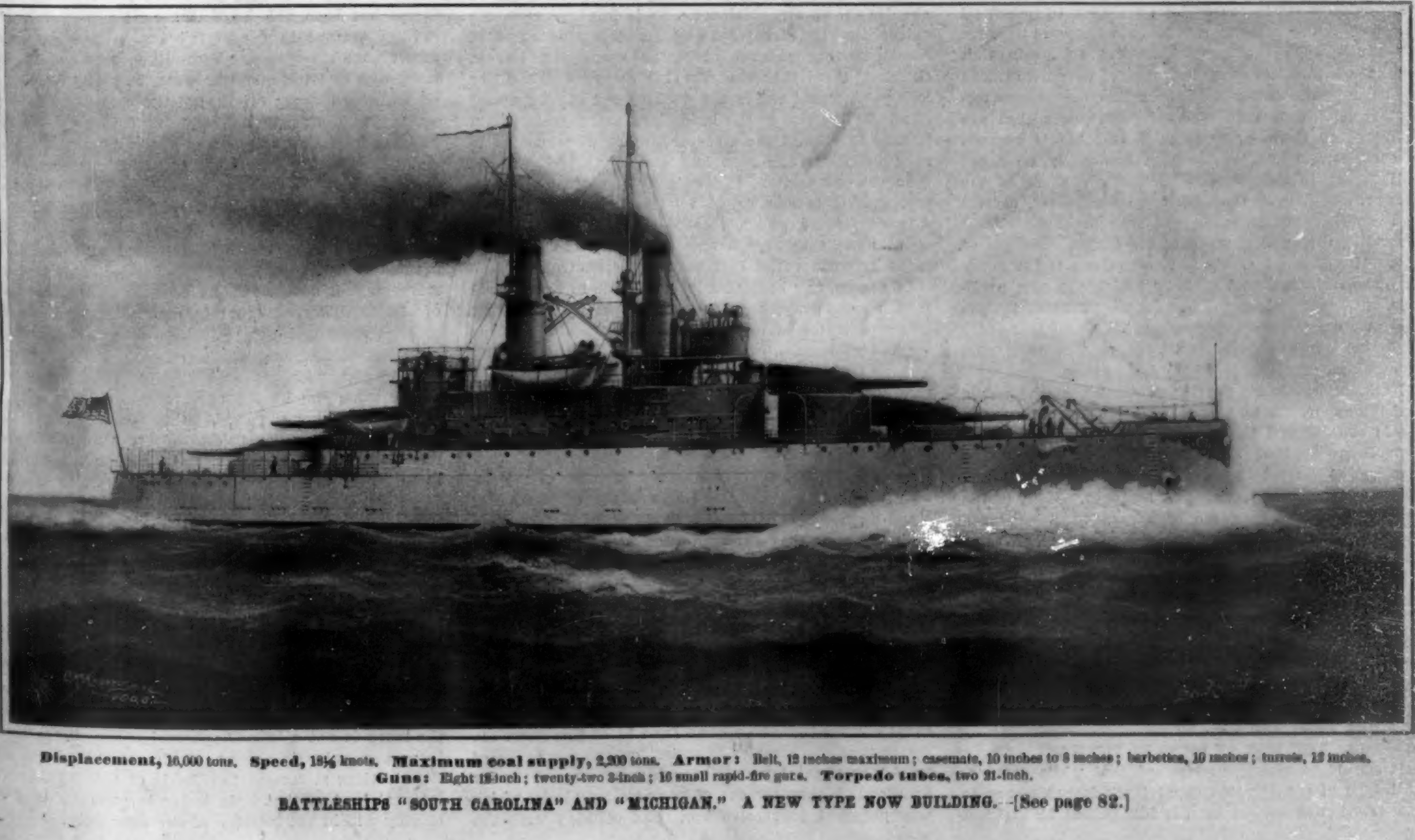


Displacement, 14,948 tons. **Speed,** 19 knots. **Maximum coal supply,** 1,700 tons. **Armor:** Belt, 11 inches to 4 inches; side armor, 6 inches; turrets, 12 inches to 6 inches; deck, 3 inches. **Guns:** Four 12-inch; eight 8-inch; twelve 6-inch; 42 small rapid-fire guns. **Torpedo tubes,** four 21-inch. **Complement,** 776.

BATTLESHIP "NEBRASKA"—ONE OF FIVE RECENTLY COMPLETED SISTER SHIPS.



Displacement, 16,000 tons. **Speed,** 18½ knots. **Maximum coal supply,** 2,200 tons. **Armor:** Belt, 12 inches maximum; casemate, 10 inches to 8 inches; barbettes, 10 inches; turrets, 12 inches. **Guns:** Eight 12-inch; twenty-two 3-inch; 16 small rapid-fire guns. **Torpedo tubes,** two 21-inch.

BATTLESHIPS "SOUTH CAROLINA" AND "MICHIGAN." A NEW TYPE NOW BUILDING. [See page 82.]

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NEW YORK, SATURDAY, AUGUST 4, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RAILWAY BLOCK SIGNAL LEGISLATION.

One of the most important acts of the last session of Congress was its instructions to the Interstate Commerce Commission to investigate the use of block signals for railroads, and gather the necessary data to enable Congress to frame and pass a suitable law calling for their adoption by the railroads of the country. The joint resolution of the two houses is the somewhat tardy reply of Congress to the oft-repeated recommendation of the Commission that a law be passed requiring the use of block signals and other modern devices for the protection of passengers and employes.

As a powerful commentary upon the need for such legislation there comes the recently-issued bulletin of the Interstate Commerce Commission, covering the quarter ending March 31, which shows that we are keeping up our unenviable distinction of killing and maiming a larger percentage of passengers and employes than the railroad systems of any other country on the face of the earth. We learn from this bulletin that the total number of collisions and derailments for the three months was 3,490, and that of this number 289 collisions and 167 derailments affected passenger trains. It is probable that 75 per cent of these 289 collisions would not have occurred if the lines on which they happened had been equipped with an adequate block signal service, or if the block signal system, as installed, had been permitted to exercise its proper absolute control over the movement of trains.

Theoretically, and, if we may judge from the wonderful immunity from accident of the best European systems, practically also, block signals are an absolute preventive of collision, and this for the obvious reason that they are based on the principle that no train shall ever pass any point on a stretch of track until it is certain that that track is clear of all other trains up to a certain point beyond; or, in other words, that there shall always exist a definite space interval between any two trains, whether they are running in the same or in opposite directions on the same line of track.

The method of control of trains from a central train dispatcher's office, by means of telegraphic orders delivered to the train crew, has been tried and found wanting, at least in respect of its ability to safeguard the lives of the passengers. It embodies, and depends too much upon the human element to attain that degree of faultless working which the tremendous issues at stake demand. Telegraphic orders are forgotten; trainmen read wrongly the orders that are delivered to them, or mistake their contents because of careless and hasty writing. Occasionally, an agent will forget to deliver an order, while there is the ever-present danger that the train dispatcher, careful and conscientious as he may be, may make some fatal error in keeping the record of his trains. The surest preventive of these errors is to adopt one of the many successful block signal systems which are now available, and make an ironclad law for the trainmen that its indications are to be absolutely obeyed, and that there is to be, under no circumstances, any running past signals and creeping up to the one beyond.

National legislation for the protection of the public and the employe is no new thing. The use of the automatic coupler and the air brake was long ago made compulsory by law; and the effect of this legislation was soon apparent in the statistics of accidents, and particularly those affecting the employes. Many of the important railroads of the country have adopted the block signal system, but there are others which seem to need the pressure of national legislation before they will move. In the interests of humanity, and as a matter of national self-respect, it is to be hoped that the next Congress will witness the passing of a suitable law which, as in the case of the legislation regarding the air brake and the automatic coupler, will insure the gradual extension of this admirable device to every railroad in the country.

THE RISK OF LOCKS IN FLIGHT.

It should be clearly understood that while the general type of the Panama canal (lock in preference to sea level) was settled by the bill passed in the last Congress, the final location of the locks and dams was left for further deliberation, and will probably be determined upon at the December session. As our readers are well aware, the Scientific American was in favor of the adoption of the lock canal as recommended by the minority report of the Advisory Board of engineers and adopted by the Canal Commission. We considered that, in view of the critical juncture which occurred when the Advisory Board found itself divided on the question of type, it was advisable, in indorsing the minority plans, to refrain from certain criticisms of its details which suggested themselves to us at our very first inspection of the plan. Criticism of details might readily have been mistaken for criticism of the lock canal plans on general principles. Now that the crisis is past, and a lock canal of some type or other is assured, it is in order to indicate one or two features of the plans to which we think the most searching criticism should be directed before the nation is committed to their construction.

The largest interrogation mark is to be set against that feature of the plans which calls for the construction of three great locks with a total lift of 85 feet, "in flight"; that is to say, with the locks leading directly from one to the other in the form of a flight of gigantic steps. Our objection to this arrangement is not based so much upon considerations of the difficulty of finding a continuous stretch of suitable rock foundation to carry the great structure, although doubts have been raised upon this point, but upon considerations of the undoubted risks of operation to which the whole canal would be exposed by placing these locks in flight. We have in mind the ever-present danger to which the Gatun locks, in common with every lock throughout the world, will be exposed of being run into and carried away by some steamer that is making the passage. If a vessel, after crossing the lake, whose level will be 85 feet above the level of the canal at the foot of the lowest lock, were, through some misunderstanding of engine-room signals, to collide even at a very low speed with the gates of the upper lock, they would be crushed in like an eggshell, and a veritable Niagara of water, 90 feet wide and 28 feet deep, would rush into the lock below, carrying the vessel with it at a speed of probably 10 to 15 knots an hour. The impact of the water on the gate at the end of the second lock, to say nothing of the momentum of the ship itself, would carry this gate away, and a second 28-foot cataract would be formed, the process being repeated until the ship had swept through the whole flight and the waters of the lake above, covering over 100 square miles of area, were roaring down through the 85-foot cataract on their way to the Atlantic Ocean. The impact of the ship as she was swept through the locks, coupled with the enormous momentum of the falling waters, would unquestionably fracture the walls and bottom of the locks, and the mass of water would speedily loosen up and sweep away the whole fabric, cutting out for itself in the alluvial soil and underlying clay a channel which, by the time the lake was drained dry, might easily be 200 or 300 feet wide and over 100 feet in depth.

The above picture has nothing in it sensational or overdrawn, as any engineer who is familiar with the extraordinarily disruptive and disintegrating effect of swiftly-moving masses of water very well knows. Granted, then, that the carrying away of the upper lock gates would end in the washing out of such a vast chasm at the site of the locks, how many years would it take to rebuild the structure, much of whose natural foundations had been torn away?

In this connection, it is a significant fact that the strongest objections raised by those engineers on the Advisory Board who advocated a sea-level canal were based upon this very danger of the wrecking of the locks by some vessel that was out of control.

Of course, any kind of a lock is liable to be wrecked in the same way; but the peril is particularly great where a series of locks is arranged in flight. In a single lock the fall of water is limited, and the loss of water is due merely to the stretch of level between that lock and the one above it; in the Panama canal the fall would be enormous, and the whole summit level would be drained dry.

That the earnest protest of Mr. Hunter, chief engineer of the Manchester Canal and a member of the Advisory Board, against the Gatun flight of locks was based upon well-considered reasons, will be understood when we state that during the few years that the Manchester ship canal has been in operation, lock gates have been carried away by colliding vessels on no less than four occasions; and, mark you, these vessels were ships of very moderate tonnage, and not the great ocean freighters of from ten thousand to thirty thousand tons displacement, which in the future years will be passing through the Panama canal.

The latest carrying away of locks on the Manchester canal occurred as recently as June 21 of this year. It seems that the steamer "Cassia," carrying a cargo of 1,438 tons of sulphur ore, through some error, made for another lock than the one of two adjoining locks which was prepared to receive her. She collided with the lock gates, and although she had very little way on her, carried away the gates, with the result that the reach of canal above was drained of its water, and the whole traffic of the canal stopped until new gates could be put in.

The risk of collision is due to the ever-present danger of a misunderstanding of signals from the bridge to the engine room, a striking illustration of which was the recent collision of the "Deutschland" with a pier at Dover. This is a menace which will be present on every ship that uses the canal; and although the minority plan calls for the construction of safety or fender gates fifty feet from the main gates, it is easily conceivable that a thirty thousand or forty thousand ton ship would crush through both gates before her momentum, even at slow speed, was expended.

In view of the accidents in the Manchester ship canal, we think that every alternative plan which would enable the locks to be separated and placed as far as possible in single steps should receive most careful study before the final plans of the canal are definitely determined upon.

THE THICKNESS OF THE EARTH'S CRUST.

Further information of a valuable character concerning the thickness of the earth's crust, and the intensity of the heat of the globe's internal fires, has been obtained as the result of a series of investigations continued over a prolonged period by the Hon. R. J. Strutt, F.R.S., the well-known British scientist and son of Lord Rayleigh. Since the first discovery of radium by Madam and Prof. Curie, this scientist has been engaged in a continued and deep study of its various and peculiar phenomena, and has contributed to our scientific literature an excellent work on this new element. Simultaneously he has been engaged in a careful computation of the average amount of radium contained in the various representative igneous rocks to be found on the external surface of the earth.

The rocks have been gathered from all parts of the world, and comprise granites from Cornwall and Rhodesia, basalt from Greenland, the Victoria Falls, and Ireland; syenite from Norway, leucite from Mount Vesuvius, the object being to extract and ascertain the proportionate amount of radium present in each.

The fragments of rock were decomposed by means of chemicals, thereby breaking up the various constituents, the yield of radium present being determined in a quantitative manner by the extent of its emanations. Owing to the slow decay of these emanations, they may be safely stored with a mixture of air in a suitable holder, thereby enabling the photographic and electrical action to be investigated at a later date. Strutt stored the dissolved rock solutions until the emanations had developed to the required extent, at which point they were extracted by boiling and measured in a specially-designed electroscope, by which process it was possible to ascertain the extent of the radium present. In order to render his calculations absolute, and to establish a standard of measurement, a similar process was carried out with a uranium mineral, with which was associated a known radium content.

As the result of these prolonged investigations, Mr. Strutt has been able to determine the percentage of radium present in the earth's crust. He has ascertained that the presence of radium, whether it exist in minute or large quantities, can be easily denoted in all rocks of igneous origin, but the percentage is highest in granitic formations, while the basaltic rocks contain the minimum proportions of the element. He has also provisionally calculated the total quantity of radium present in each mile of depth of the globe's crust, from its uniform distribution, and estimates on this basis that not more than one-thirtieth of the total volume of the earth is composed of rocks which are to be found on the surface. As a result of his mathematical deductions, he estimates that the depth of the earth's rock crust is approximately forty-five miles. This deduction coincides to a certain degree with the calculations of Prof. Milne, the well-known seismologist, who has been engaged in investigations to the same end by the observation of the speeds of earthquake tremors. Prof. Milne concludes that at a depth of thirty miles below the earth's surface exist rocks whose physical properties are similar to those to be found on the exterior.

Mr. Strutt has also advanced interesting data regarding the temperature of the internal heat of the globe at the base of the rock crust forty-five miles below the surface. This he computes to be approximately 1,500 deg. C. Such a heat indicates the melting point of iron, but it is considerably below the melting point of platinum, which Dr. Harker has fixed at 1,710 deg. C.

Furthermore, as a result of his researches Mr. Strutt is in agreement with the assumption advanced by several astronomers, more especially Mr. Pickering, that the moon is not a "dead" sphere, but that it continues to possess volcanic energy. And moreover, he makes the startling statement that he is of opinion that the internal heat of that body is far in excess of that obtaining within the interior of our own globe.

BOTANY UP TO DATE.

A readable article by R. Francé on "The Form-Feeling of Plants" appears in Ueber Land und Meer. It begins by speaking of the revolution in natural history effected in Germany (in common with the other countries in which that theory has been accepted) by Darwinism, and what it has led to. The adaptation of the instruction in natural history in the German intermediate schools to the progress of the science in the last ten years, no longer making the naming and recognition of plants and animals, and their ranging into systems, the main point, but "the introduction of the pupils into the manifold phenomena of Life," will now, the writer declares, "for the first time implant the genuine love and understanding of Nature enduringly in the rising generation."

For the first time, in the last decade the plant was recognized in its true nature. And in uninterrupted sequence since then, two young yet aspiring sciences, plant-physiology and plant-ecology, have made the surprised learned world acquainted with what is new and almost incredible; using the abundance of intricate and most skillfully adapted phenomena of life which show that the plants, apparently so quiet, through sensation and a kind of "experience" share in life's joy and sorrow equally with all other creatures. There was discovered in quick succession in the higher plants a number of (partly even intricate) organs of sensation which prove that the plant is very noticeably sensitive to pressure, to the attraction of gravitation (scarcely perceptible to us), to touchings, to the proximity of nutritious substances.

One of the most recent physiological discoveries has, however, not yet gone beyond the specialists, and yet it gives such a deep insight into the strangeness and (according to our other ideas) foreignness with which the life of plants expresses itself, that it must be of greatest interest to the widest circles. This is the form-perception (morphæsthesia) of plants. This strange name the Berlin botanist, Prof. Roll, inflicted recently upon the fact discovered by him, that the position of their organs exerts a stimulus upon plants. In experiments with sprouts and young specimens of the most varied food-plants, he noticed that on their vertical or bow-shaped principal root the little side roots are always so arranged that they stand only on the convex side of the curvature. This strange behavior can be no accident, for it is found throughout their distribution among all examined plants—ferns as well as trees and shrubs. The layman would probably find in this behavior only an interesting fact; the botanist was forced to say to himself that a phenomenon of such universal scope could only be the expression of a special obedience to law. Roll investigated it also in experimental ways, and forced roots into certain artificial curvatures, with such success that the new-forming little side roots formed themselves again only on the outward-curved side of the principal root.

It thus appeared that the organs of plants are bound to a quite fixed mutual position; and this, all at once, sheds light upon many relations hitherto enigmatical. It had long been noticed that all plants have an appearance highly characteristic of them and exactly determined, i. e., brought about by the fact that, in all variability of size, of leaf-forms, of exuberance in the development, yet the mutual place of the branches, leaves, and blossoms is fixed with perfect regularity—somewhat as different buildings are obliged to correspond with each other, when they are built in the same style. This was called the habit of plants. It is unconsciously familiar to everyone schooled in nature, for this habit it is by which from a distance the woodsman can distinguish, e.g., the fir tree from the pine tree so like it. By the most varied considerations (the discussion of which here would lead too far), attention now came to be given to the question of the single factor by which this habit is governed; and it was found that it is caused, first and foremost, by the arrangement of the side limbs, branches, twigs, leaves, which for every plant produce a mathematically constant type. Within this type, then, the individual variation creates the differences between the single plant-individuals, which otherwise would have to resemble each other as one egg another. This individual variation, however, depends upon the nourishment conditions and the fitness of the individual for its special life conditions. That was a very significant discovery, which first makes the special life of plants comprehensible to us. They possess the capacity in the most wonderful fashion always to make the most of the given circumstances and adapt themselves to them so as to reach the normal life conditions. The best witness thereto is their habitat.

As this capacity was investigated, the most incredible proofs were reached with what exquisite adaptation to plan the forces of Nature act. For example, the leaves of plants stand in a fixed order, so that all may share the sunlight. This is the case even with the thickest-foliaged treetop. All the branches, twigs, and petioles grow in such fashion that this aim is reached; in subservience to it, too, leaves place themselves according to need diagonally, horizontally, or at the top vertically, to avoid unnecessary shadow. It had often been asked why the leaves of different plants are cut up, lobed, and sinuate in so wonderfully manifold a manner. The answer was received when it was noticed that, beheld from above (and so from the standpoint of the sunlight), each sinuation makes room for the projection of a leaf, from below or above. . . . There had, all at once, been found the explanation of the inconceivable variety of the leaf forms. If nothing else will do, the topmost leaves perforate themselves merely that some sunlight may be made possible through the rifts. This will be found the case with the favorite foliage plants, the philodendrons, which, just by reason of these elegantly perforated leaves, acquire an appearance so odd and hence so useful for gardening purposes.

This mutual struggle for light that is peaceably adjusted by mutual accommodation (what an admirable natural prototype of the social struggle!) is, however, renewed in a tree each year, since the old relation of equilibrium is disturbed by the new twigs. But that it is nevertheless always brought about again proves that the plant possesses, not an inherited, general, but an individually variable capacity therefor—which is not thinkable, without a feeling for the existent bodily form. This necessarily caused the plant physiologists to claim that the form perception (previously studied by Roll in the roots) it is that prescribes for the branches and leaves, too, their always orderly mutual position. And it was an admirable confirmation of this view that the characteristic habit of plants always seeks of itself to establish itself again, when it was disturbed by any kind of elemental injuries, as storms, floods, and the like. This form-feeling explains also the strange and otherwise wholly enigmatical plan-following of the tendency of growth in twigs and branches, which prevents the boughs of trees from mutually hindering each other and in growing injuring each other.

To how high a degree this strange perception advances the most serviceable processes of plant life, a new proof at once appeared from a different quarter. Prof. Neger, of Eisenach, called attention to the fact in how remarkable a manner many plants are seen that are compelled to gain a bare living on steep precipices. In the German secondary chain of mountains, are usually found in such places small specimens of the universally-known chickweed or of herb-robert (*Geranium Robertianum*), which, rooted merely in a crack, would at once lose their hold and indolently hang down, if they could not help themselves in this serious predicament in a very peculiar way. To wit, they bend downward the stems of some of the bottommost leaves and lay the leaf surfaces closely upon the rock or the mosses flourishing thereon. The stems of these leaves at once become stronger and form themselves into organs of support, by means of which the plant stands even upon the almost perpendicular wall as if upon firm feet. Of course the leaves used for such purposes soon die off; the petioles, however, remain vigorous and sound, and finally often the whole plant stands upon a scaffold on stilts composed of such petioles, which possesses the still further advantage that dust, earth, and the like collect upon it—sufficient material to improve the scanty soil for the unassuming plant. The building of these remarkable stilt apparatus is no work of accident, but lies (if one dare so express himself) in the *intention* of the plant. For, when Prof. Neger cut off some of the supports, some of the bottommost leaves at once sank down and formed a new support. In the highest degree worthy of note was it, that for this were used only the leaves to be turned down from the rocky wall *outward*—thus only those that were alone available for effective support. All these facts doubtless rest upon the form-feeling, upon a stimulation from the abnormal position of the individual that had as a result the movements of the leaves remedying the evil.

An explanation of form-feeling we cannot at present, it must be admitted, give. We can only help ourselves by saying that this capacity is one of the universal properties of animate matter. One, however, feels in so doing that this kind of explanation is really merely a paraphrase of the facts, and does better, indeed, quietly to confess that we here stand again before a riddle of life. Only of this there can be no doubt: we must ascribe to the plants a richly-developed sense-life. They possess all the beginnings of perception, and perhaps even of finding their bearings in the universe. The same life throbs in them, though less developed than in ourselves; and it is, indeed, more than a mere poetic simile, when our greatest poet speaks of our brothers in forest and plain and field.

NEW SULPHUR PROCESS FOR THE PRESERVATION OF WOOD.

Consul R. M. Bartleman, writing from Seville, says that the faculty of wood to withstand atmospheric pressure is so small, compared with its mechanical resistance, that a close study of new systems aiming at its preservation is of great interest industrially.

All the wood preservative methods now employed are defective in so far as they make use of solutions the evaporative nature of which makes their action upon the wood effectual only for a certain time. The new method in question, which has been patented in Germany, goes further and utilizes a fixed body which becomes solid upon being instilled into the pores of the wood. This substance is sulphur, the physical properties of which offer interesting advantages, being fusible at about 115 degrees, a temperature which the wood can support without any perceptible change. The sulphur is applied in liquid form, and in hardening completely fills up all the interstices of the fibrous tissue.

Although sulphur oxidates easily if subjected to a high temperature, at a medium temperature it remains impassive, resisting not only the influence of water but also that of acids, concentrated or diluted, and alkaline solutions, if cold. The reason why the utility of sulphur in the direction indicated had not been recognized ere now was on account of its small mechanical resistance, pure sulphur being very brittle and pulverous. But as wood possesses the quality of mechanical resistance of which sulphur is devoid, the compound of these two bodies may, under the proper conditions, easily acquire valuable industrial properties, as, for instance, the vulcanized caoutchouc, which the wood, impregnated with sulphur, resembles a good deal.

To protect wood by means of sulphur the following must be observed, viz.: Sulphur is fused in a befitting receptacle, making use of steam to avoid an excess of heat, which deteriorates the sulphur. Into this liquid, and at a temperature of about 140 deg., are steeped the boards which are to receive the treatment, care being taken to immerse them completely. The foam which gathers at first, called forth by the separation from the wood of the air and humidity it contains, disappears at the moment the wood thoroughly assimilates the temperature of the bath, which is then lowered to 110 deg. At this point the sulphur becomes hard and, while the air contracts itself, the sulphur penetrates into the fibrous tissues, propelled by atmospheric pressure. The boards are then slowly withdrawn from the bath, allowing a thin and even coat of sulphur to form and cover the wood, as any superfluous surcharge can be removed only with the greatest difficulties afterward. This coat of sulphur has a vitreous appearance and forms a very tenacious crust, excluding all tendencies to chip or break.

The degree to which the wood is impregnated varies according to the nature of the wood, the temperature, and the duration of the bath. It may be gaged by the increase in weight of the boards, which amounts to from 30 to 35 per cent where the process is conducted in an open receptacle, and to 100 per cent if in a vacuum pan. Theoretically it may be said that a complete fullness of the pores of the wood would increase its weight by 200 per cent.

In numerous experiments poplar was the best wood to take the sulphur treatment. Oak and pine wood do not admit of the process quite so favorably, because their dry distillation begins at 140 deg., which can be proved simply by observing that while the wood is immersed in the bath bubbles are continually rising, marking the escape of volatile substances. Moreover, the resin blackens the sulphur. The process in question has up to date been applied only to thin boards, but in view of the satisfactory results the hope is entertained of its soon becoming popular for timbers.

BOLOMETRIC MEASUREMENTS IN WIRELESS TELEGRAPHY.

The experiments in bolometric measurements carried out some years ago by C. Tissot, which were published in Inst. Elect. Engin. Journ., were in all respects similar to those of Duddell and Taylor with a sensitive thermo-detector placed in the aerial. This was in the form of a Langley bolometer, carefully insulated from heat disturbances by a vacuum jacket or otherwise. The sending and receiving aerials were "simple," i. e., direct connected. It was found that by varying the value of a non-inductive resistance arranged in series with the instrument in the receiving aerial there was a best value for the resistance from the point of view of the energy absorbed. Tests carried out in 1904, with aerials tuned to minimize the harmonics, up to distances of 9 kilometers showed that the received current varied inversely as the distance. These were extended later to 40 kilometers, and agree with the law given by Duddell for greater distances. The results of Duddell and Taylor, which show that the effective value of the current observed is proportional to the square root of the number of wave trains per second, were also confirmed. The following figures show the variation of received current with distance; the sending current being 2.8 effective amperes with 26 sparks per second; at distances 1.15, 8.0, and 40 kilometers the received currents were 8,290, 1,180, and 235 microamperes respectively, the product current × distance being 9,550, 9,450, and 9,400 in the three cases respectively. These values are likewise in agreement with Duddell's results.

THE SULPHUR MINES OF LOUISIANA.

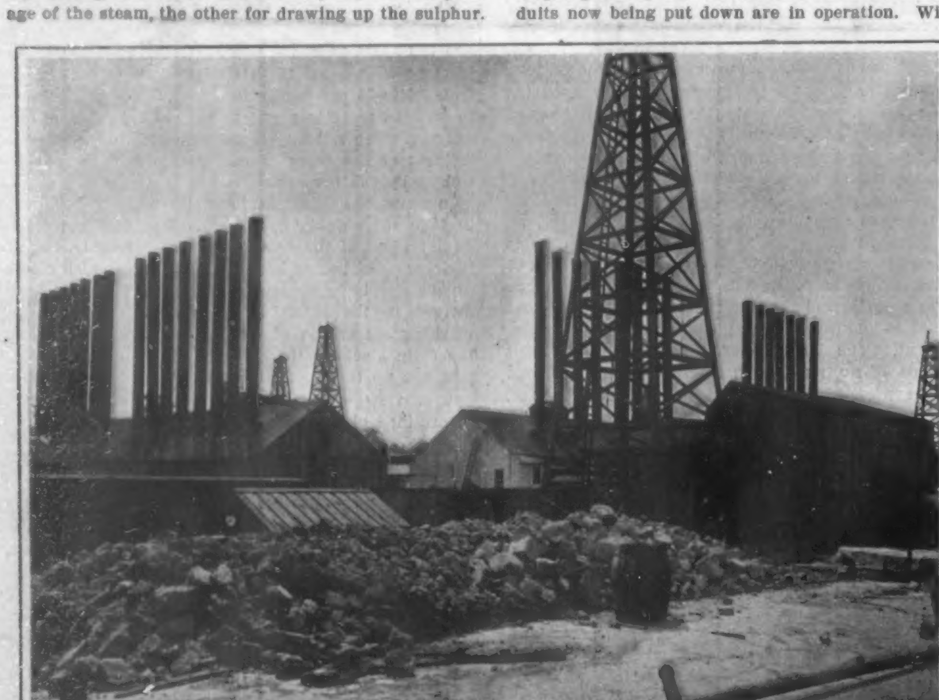
BY DAY ALLEN WILLEY.

The discovery that extensive deposits of sulphur existed in the State of Louisiana was made several years ago, but until recently the substance could not be obtained from these beds, owing to the distance at which they are located from the surface and the foreign bodies which intervene. Indications of sulphur have been found in various portions of Calcasieu Parish in the State named, especially in the form of springs of water strongly impregnated with this mineral. One prospector succeeded in drilling through to the bed which is now being worked, and discovered that it was not only of a high grade, but over 100 feet in depth.

For several years attempts to secure sulphur in commercial quantities failed, owing to a layer of quicksand which exists above it. The thickness of the quicksand varies. The greater portion of the bed is estimated to range between 100 and 200 feet, the sulphur itself lying at a depth varying from 600 to 800 feet. The problem of getting the sulphur through the sand without mixing the two substances has been an extremely difficult one; but it has finally been solved to such an extent, that from this bed is now coming the bulk of the sulphur produced in the United States, if we except that secured from pyrites.

Generally speaking, the following method is employed in obtaining the sulphur: Wrought-iron piping is driven through the upper formation and the sand bed, by steam-driven apparatus somewhat similar to that employed in putting down tubing for petroleum wells, but the machinery required is much more powerful. The tubing utilized is of two sizes, one for the passage of the steam, the other for drawing up the sulphur.

Sulphur Ready for Shipment by Rail After Solidifying in the Drying Vats.



General View of a Sulphur Mining Plant Which Yields a Thousand Tons of Sulphur Daily.

The steam pipe is connected with a pump and boiler of sufficient power to force a jet from the surface to the sulphur. The contact of the steam with the material, which in its natural state is in a solid form, converts it into liquid; in other words, melts it so that it can be drawn up through the discharge pipe by means of air pressure. This is supplied by a series of powerful compressors, which bring the liquid sulphur to the surface, in the same manner as a column of water is carried by pneumatic pressure for irrigation and other purposes, the conduits being installed in pairs side by side.

The end of each discharge pipe is set in a vat of suitable proportions. This vat is usually a shallow excavation in the ground, lined with concrete or some other material, and open at the top, so that its contents are exposed to the action of the sun and air. Here the sulphur is again solidified by natural evaporation, when, after being broken up into masses of convenient size for transportation, it becomes a commercial product ready for shipment to the refinery or point of consumption.

As mentioned above, the quantity of sulphur secured from the Louisiana deposit has already assumed such proportion, that with the exception stated it is furnishing the bulk of the American supply. The operations are as yet conducted by one company, and much secrecy is maintained as to the average output. The plant is now being enlarged on such a scale that the present output probably will be doubled, when all of the conduits now being put down are in operation. With the additional conduits in service, the yearly production will be over one-third of the total quantity consumed in the United States, which at present averages about 500,000 tons. But as yet only a small quantity of the deposit known to exist has been secured, for it has been traced a distance of fifteen miles from the present workings. Excluding the sulphur extracted from pyrites, the Louisiana deposit will yield far more than any other country where sulphur is secured from natural formation, with the exception of Italy, whose thousand mines furnish nearly 600,000 tons annually. The Italian sulphur in its original form, however, is far inferior to the American article, for the rock from which the commercial product is refined averages less than 20 per cent of pure sulphur. It is claimed that the Louisiana grade does not contain over 2 per cent of foreign matter, so that it is available as it comes from the wells for many compounds into which it is manufactured, while it can be refined at a minimum cost. While the exact percentage of pure sulphur is not made public, its high grade is verified by the fact that it is sent away by the carload to various points of consumption in this country, and but a small quantity goes to the refinery. In fact, so much of it is being shipped to fertilizer works, that steamships leaving New Orleans have been known to carry as much as 1,000 tons as part of their cargo. It might be added that the material is transported in bulk like so much coal or iron, and is stored in the open air like this material.

As the Louisiana deposit is further opened, it is likely that this State will yield the world's greatest tonnage of sulphur, when comparison is made with other deposits now being worked. Aside from Italy, Japan is the next greatest producer of crude sulphur. Most of the Japanese grade comes from Moyoro Bay, which is located on an island about 2,000 miles north of Yokohama. Here a formation of sulphur lies on the slopes of three volcanic mountains to such an extent that it is estimated fully 1,500,000 tons can be obtained by merely digging off the surface. At present only about 16,000 tons are being secured yearly, of which 10,000 tons are shipped to the Pacific coast of the United States. Outside of Italy and Japan, the United States has no other competitors of consequence. The only other American sulphur deposits being worked are in Humboldt County, Nevada, and near the town of Marysville in Utah, but neither of these yields a thousand tons annually.

It is understood that at present about twenty pipe lines have been driven into the Louisiana bed, the material being extracted through tubing four inches in diameter. The maximum capacity of the plant will be about forty wells when the present enlargement is completed. The present industry is situated in what is known as the coast prairie, a short distance from

Pumping up the Liquid Sulphur into the Vats Where it is Evaporated.

THE SULPHUR MINES OF LOUISIANA.

the town of Lake Charles and in the southwestern part of the State. Geographically, it is believed to form a portion of what is called the Gulf coast oil belt, which includes the Jennings petroleum field, also the Beaumont and other fields in eastern Texas.

A RAILROAD COACH CONSTRUCTED IN FORTY HOURS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An interesting feat was recently performed at the Parel Works of the Great Indian Peninsula Railroad, which in view of the peculiar conditions prevailing, and the fact that it was accomplished entirely by native labor, proverbially slow, is most remarkable. In the early part of this year the company required a special type of trailer coach, to be used with a small tank locomotive, at extremely short notice. Under the circumstances, it was decided to test the capacity of the works and the native laborers in regard to rapid construction.

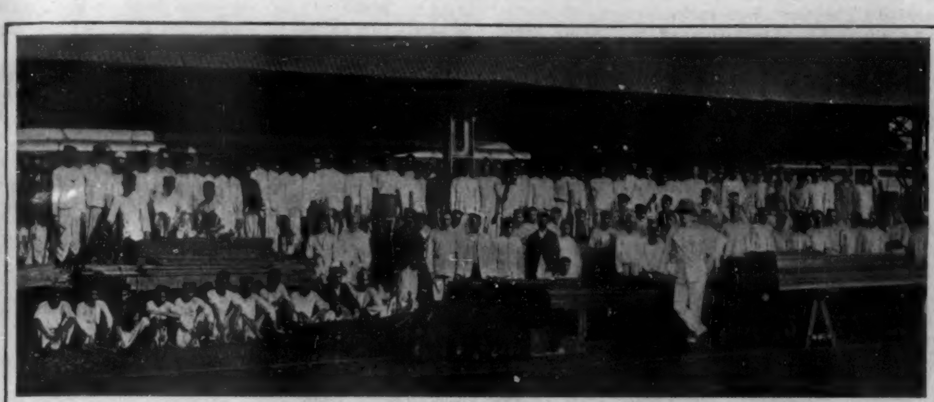


Fig. 1.—Men and Material Ready for the Start on Monday Morning at 8:30.

Special drawings had to be prepared, and these were put in hand on March 1. As rapidly as possible the orders to prepare the material were assigned to the various departments, so that all material might be ready for assembling upon the same day. By the 26th of the month everything was in readiness, the consignments of the respective materials being delivered at the spot where the work of erection was to be carried out. The men, aggregating eighty-eight in number, under the direction of eight "maistries" and superintended by Mr. A. M. Bell, the carriage and wagon superintendent of the railroad, to whose courtesy we are indebted for the accompanying illustrations and details of the operation, were drawn up at 8:30 on the Monday morning, in the manner shown in the first illustration. Punctually at the half-hour they were set to work. The company were divided into various gangs, each of which carried out a particular operation. Some commenced work upon the bogie trucks and steel underframe, while others prepared the sides, ends, floors, and roof. By the time work finished for the day at 4:30 in the afternoon, considerable progress had been made.

It was decided to carry out the work without undue pressure, no overtime being permitted, the length of the working day being limited to eight hours, which ordinarily prevails in the works. The men recommenced work the following day at the same time in the morning, and maintained the excellent progress that had been established during the previous day. The underframe was sufficiently advanced for the superstructure, the end sections of which were quickly secured in position, while the floor gang at once entered and completed their work. During the afternoon the ribs for supporting the roof were fixed, and by the time work was discontinued for the day, the actual erection had been more than half completed.

When the task was resumed on Wednesday morning, the coach had reached the stage shown in our second photograph, which was taken immediately after starting. The underframe was completed and the roof laid. Of the total gang, sixty-six of the men were carpenters, and these now busily set to work preparing the doors, windows, seats, and other accessories, while nine upholsterers were simultaneously engaged upon the cushioning and trimmings for the seats, blinds, and so forth. In the afternoon all erecting work had been completed, and when the men finished, the body had received its first priming coat of paint.

The next morning painting of the inside and outside of the coach was hurried forward. The outer covering for the roof was attached, and the carpenters and glaziers fixed the windows and doors, while the upholsterers proceeded with the seats and trimmings.

Fig. 2.—The Car on Wednesday Morning, at 8:30, After Sixteen Hours Work.

All the hard internal work was completed on this day, so that Friday could be devoted to carrying out the final finishing processes. On the latter day the final coats of paint and varnish were applied throughout, the electric light fittings installed, vacuum brake fitted, and various embellishments, such as door handles, hand rails, and the like, applied. The lettering was also completed, so that at 4:30 in the afternoon, when the third photograph was taken, the task was ended, and the coach ready for the rail. The actual working time spent upon the undertaking was forty hours, from the moment when the men set to work on Monday morning.

In the construction of the carriage 600 feet of Australian timber was used, and all this had to be machined, planed, cut, and accurately fitted. The woodwork department had to make 19 doors, 92 windows, and 92 shutters, which had to be hung and fitted. The engineering staff had to erect all the steel underframe, the necessary material for which was simply delivered to the erecting point.

The car upon which this Indian record was established is of the typical local service variety. It measures 62 feet in length by 9 feet 6 inches wide. The steel underframe is 60 feet over all, and is carried upon two four-wheeled bogies placed 40 feet apart from center to center. The internal fittings are somewhat intricate, as the coach is of the composite type, there being the conductor's compartment at one end, followed by the first-class accommodation, capable of seating six passengers. Then follows a spacious third-class compartment seating forty-eight persons, with a small compartment for the accommodation of twelve females, who in accordance with the Hindoo custom travel separately.

Beyond this is a small space for the stowage of baggage. The car being intended for suburban work, running in either direction, the seats are of the turnover pattern.

The railroad authorities expressed themselves as highly satisfied with the efficiency of the staff, since the native is not apt to be hurried over his work. Fortunately, the men entered into the enterprise with commendable zeal, determined to establish a record for native labor. In such circumstances and under such conditions, it is difficult, even when a programme of work is carefully drawn up, to adhere very rigidly to the details thereof, owing to the labor problem; but in this instance, owing to the organization of the European staff and their careful handling of the natives, the work was carried out without any difficulty. Had pressure been employed and overtime worked, the undertaking might have been completed in a much shorter time, but it was not deemed advisable to resort to such extreme measures in a torrid climate. At the same time, however, it demonstrated what can be accomplished with native labor when it is competently handled. On Saturday morning the coach was officially inspected, and no traces of scamping, such as might have been anticipated, were discovered, the work being carried out with as much care and thought as if undertaken in the normal manner.

Fig. 3.—The Finished Car on Friday at 4:30 P. M.

A RAILROAD COACH CONSTRUCTED IN FORTY HOURS.

Termination of the Glidden Tour.

As we go to press the last stage of the Glidden tour —124 miles from the Rangeley Lakes, Me., to Bretton Woods, N. H.—is being traversed. Fifty-eight cars are still in the tour, thirty-six being contestants for the Glidden Trophy, and fourteen of these still having perfect scores. In order to eliminate some of the latter, checkers were placed every 15 miles apart instead of every 25. In all probability ten or a dozen cars will finish the tour on an equal footing, and consequently no one car can be said to have won the trophy. The tour has given a complete demonstration of the ability of the American machine to traverse, at a relatively high speed and without serious breakdowns, the worst roads in civilized communities in North America.

RECENTLY COMPLETED BATTLESHIP "NEBRASKA."

The largest class of battleships of the United States navy is the "Georgia" class, which comprises five ships—the "Georgia," "Nebraska," "New Jersey," "Rhode Island," and "Virginia"; and of these the last to be completed will be the "Nebraska," which forms one of the subjects of illustration on the front page of this issue. Especial interest attaches to this ship because of the fact that she was built in the young State of Washington and at the thriving city of Seattle, which, a quarter of a century ago, was not much more than a village in size. The construction of a modern battleship calls for the highest skill and a thoroughly complete and costly shipbuilding plant, and that this great vessel, with a displacement of about fifteen thousand tons, should have been built and engined in an industrial center so modern is certainly a striking evidence of the material development of this flourishing maritime city of the extreme Northwest.

The "Nebraska" and her sisters are distinguished among battleships by the extraordinary concentration of fire of the guns of the main battery of which they are capable, being in this respect, at least in the number, if not in the weight of shell which they can deliver in any direction, unsurpassed either in our own or any other navy. This concentration is obtained by the method of mounting the 8-inch guns, of which four are carried at the great elevation of 32 feet upon the roofs of the turrets containing the 12-inch guns. The other four 8-inch are mounted amidships, 26 feet above the water, in two turrets, one on either broadside. This disposition enables the "Nebraska" to concentrate two 12-inch and six 8-inch guns directly ahead or astern, while on either broadside she can deliver the fire of four 12-inch and six 8-inch guns. In the secondary battery she carries in broadside on the gun deck twelve 6-inch rapid-fire guns, and for repelling torpedo attack she mounts twelve 3-inch, twelve 3-pounders, and eight 1-pounders. She also carries two 3-inch field guns and eight small-caliber automatic guns. Her torpedo armament is also an exceedingly powerful one, consisting of four of the new 21-inch torpedoes driven by turbine engines, of the kind described in the Scientific American of January 6, 1906, which are capable of a speed of 36 knots at a range of 1,200 yards, and a speed of 28 knots at a range of 3,500 yards.

The distribution of armor on the "Nebraska" is as follows: She carries a water-line belt which is continuous from stem to stern and varies in thickness from 11 inches amidships to 4 inches at the ends. With this is associated a deck 3 inches in thickness. The main barbettes and turrets carry 10 inches of armor and the secondary turrets 6 inches. The broadside battery is protected by side armor 6 inches in thickness which extends between the main barbettes from the top of the main armor belt to the upper deck. There are 9 inches of armor on the conning tower, and the 14-pounder guns also are protected by 2 inches of armor. The total weight of armor is 3,690 tons.

The ship is driven by twin reciprocating engines, which are designed to give a speed of 19 knots with 19,000 horse-power. The maximum coal supply is 1,700 tons.

The ship has a water-line length of 435 feet; her beam is 76 feet 2½ inches, and her maximum draft 26 feet. Her complement of officers and men will consist of 41 officers, 675 enlisted men, and 60 marines. On her builders' trial, carried out on July 2 of this year, she made a speed of 18.95 knots.

OUR LATEST BATTLESHIPS, "SOUTH CAROLINA" AND "MICHIGAN."

The recent letting of contracts for the construction of the two new battleships "South Carolina" and "Michigan" to the Cramp Ship and Engine Building Company and to the New York Shipbuilding Company, has brought these two formidable vessels into special prominence, and a description of the leading features of their design will be timely.

Particular interest attaches to these vessels because of the fact that they are the first battleships to be designed by our Navy Department subsequently to the conclusion of the Russo-Japanese war, and that in their design they embody the valuable experience gathered during that great conflict. The most marked feature is the complete elimination of the intermediate battery, which in our earlier ships consisted of a large number of 5-inch, 6-inch, 7-inch, or 8-inch guns. The customary number of guns in the main battery has been doubled, so that instead of four 12-inch carried in two turrets, the new ships have eight such guns mounted in four turrets. The numerous battery of small rapid-fire guns is retained, since its service will always be necessary for the repelling of torpedo-boat attack. In length and displacement the new vessels are approximately the same as their predecessors, the "Louisiana" and "Connecticut," though with greater beam and ½ knot more speed. They are also more effectively armored than those ships, and in fighting power they are believed to be vastly superior; that is to say, if the new theories as to the probable tactics of future naval conflicts prove to be correct.

The general dimensions of the vessels are as follows: The length on the load water line will be 450 feet; the breadth is greatly increased over that of the "Connecticut," being 80 feet 2⅝ inches. The mean draft at trial displacement must not exceed 24 feet 6 inches, on which draft the displacement must be 16,000 tons.

The General Appearance of the New Battleships.—The two ships when completed will, in appearance, be distinctly different from any of our other battleships. The most noticeable feature, of course, will be the four 12-inch turrets and their guns, mounted in pairs on the axial line of the ship, two forward and two aft of the superstructure. The doubling up in the number of 12-inch turrets, and the placing of them one ahead of the other, has necessarily shortened the length of the superstructure, and crowded the masts, smokestacks, etc., into a shorter space amidships, a fact which is readily noticeable on looking at the engraving of the new ships. In order to save weight the freeboard of the ship has been reduced by the depth of one deck, or about 8 feet, from aft of the superstructure to the stern. Hence the "South Carolina" and "Michigan," while they will have the same freeboard forward as the "Connecticut" and "Louisiana," will have a lower freeboard by about 8 feet throughout the after third of the vessels' length. The most forward pair of 12-inch guns is carried at about the same height as the 12-inch guns of the "Connecticut," or say about 24 feet above the water line. Immediately abaft of these is the second pair of forward 12-inch guns, which are so mounted as to fire clear across the roof of the forward turret, the barbette for these guns being increased in height by about 8 feet in order to give the requisite elevation. The guns have the great command of 32 feet above the water line. The after pair of turrets with their four guns are mounted similarly, although at an elevation in each case 8 feet lower than that of the forward guns.

The shortening of the superstructure has been accompanied also by a moving of the two military masts toward the center of the vessel, and a distinct novelty is seen in the placing of these masts, not on the longitudinal axis of the ship, but diagonally, the forward mast being moved over to starboard and the mainmast to port. Advantage is taken of this new position to mount the boat cranes on these masts, with, of course, a considerable saving of weight.

Armor and Armor Protection.—The armor protection has been exceedingly well worked out, and forms one of the most commendable characteristics of these vessels. Its most important element is a water-line belt 8 feet in width, and more than 300 feet in length. The midship portion of the belt varies in thickness from 11 inches at the top to 9 inches at the bottom, while that in the wake of the magazine is 12 inches thick at the top and 10 inches at the bottom. The casemate side armor above this water-line belt is nearly 300 feet long; it will be 8 inches thick at the top, 10 inches at the bottom, and will be about 8 feet 1 inch wide amidships. This is a casemate protection which, in extent and in thickness, has never been approached in our previous battleships. Triangular athwartship armor, 10 inches thick, will be fitted at the after end of the belt armor, between the slope of the protective deck and the extension of the flat protective deck. Also an athwartship armor bulkhead, extending entirely across the ship between the upper platform and the protective deck, will be fitted at the forward end of belt. This will be 10 inches thick throughout. Furthermore, an athwartship casemate armor bulkhead will be fitted between the shell plating and the barbettes between the berth and main decks at forward and after ends of casemates; this will be 8 inches in thickness throughout.

Barbette Armor.—The forward barbette extends from the protective deck to about 4 feet above the upper deck, and it varies in thickness from 10 inches to 8 inches, according as it is flanked by the side armor of the ship. The after forward barbette extends to a height of about 12 feet above the upper deck, and carries the same general thickness of armor. The forward after barbette extends from the protective deck to 12 feet above the main deck, and the barbette aft of this extends from the protective deck to 4 feet above the main deck. In the case of each of the four turrets, the port plate will be 12 inches in thickness, the rear and side plates 8 inches, and the top plates 2½ inches in thickness.

The vessels will be propelled by vertical twin-screw four-cylinder triple-expansion engines of 16,000 horse-power. The steam pressure will be 265 pounds in the high-pressure valve chest, and the revolutions per minute will be 125. Steam will be supplied by twelve water-tube boilers fitted with superheaters, carried in three water-tight compartments. The vessels will be lighted throughout by electricity, and the operation of the turrets, ammunition hoists, and, indeed, most of the mechanical work throughout the ship, will be performed by electrical power. The coal bunkers will be arranged with a direct reference to the rapid and efficient supply of coal to the fire rooms, and with especial reference to efficient water-tight subdivision of the vessel. There will be provided for coaling the ships not less than five winches, ten booms, wire spans, with the necessary whips at all the usual chutes and other openings, special provision having been made for the rapid coaling of the vessels. There will be a bridge both forward and aft, built according to the latest practice. The masts will be fitted with searchlight platforms, and arranged for wireless telegraphy. There will be one signal yard on each mast, a battle gaff on the mainmast, and a lookout platform on the foremast.

Distribution of Weight.—It is instructive to study the distribution of weights in these new vessels; the guns, mounts, ammunition, and ordnance stores will represent about 7 per cent of the trial displacement; the motive power, including engines, boilers, piping, etc., about 10 per cent, and the total armor protection reaches the great figure of more than 25 per cent of the trial displacement.

Concentration of Fire.—It will be seen at once that by arranging the two extra pairs of 12-inch guns at a sufficient height to enable them to be fired across the roofs of the adjoining turrets, the theoretical all-round concentration of fire is remarkably powerful. Forward, when in pursuit of the enemy, or when fighting in the end-on position, it will be possible to concentrate four 12-inch guns, which is double the number that can be trained in a similar direction on the "Connecticut" and "Louisiana." Aft there is a similar concentration of four 12-inch guns, while on the beam these ships will be able to train eight 12-inch guns.

In a previous issue of the Scientific American we have criticised this method of placing the armament, on the ground that previous experience with the "Oregon" and her class showed that if heavy guns were fired across the roofs of the adjoining turrets, the work of the gun crews in these turrets would be seriously interfered with. We are informed, however, that particular attention has been given by the Navy Department to this difficulty, and that by virtue of the improved sighting ports and the closely-fitting port shields employed, and other arrangements, it will be possible, in an emergency, to fire any of these 12-inch guns in any position of training without serious interference with the work of the other gun crews. If this should prove to be the case, our Navy Department will be the subject for congratulation on having produced, in proportion to their displacement, by far the most powerful fighting ships built or building in the world to-day; for it must be remembered that these vessels are of but 16,000 tons displacement, while the latest battleship designs of other governments are of from 18,000 to 19,000 tons displacement.

There are many novel details of construction in these vessels, which, for obvious reasons, it is not expedient to make public at the present time—such, for instance, as the more complete water-tight subdivision of the vessel, and provision against heeling due to damage in action; and the protection of the vessels' longitudinal strength when damaged by gun fire, the provision of adequate longitudinal strength being particularly important in view of the concentration of the weight of the barbettes and heavy guns so near the extremities of the ship.

Distribution of Patent Office Models.

It appears, according to an act of Congress passed on June 22, 1906, the Secretary of the Interior is authorized to dispose of a part or of all the model exhibit of the Patent Office, either by sale, gift, or otherwise. Acting Commissioner E. C. Moore has issued a notice to the effect that immediate requests from polytechnic schools and colleges having technical courses for portions of the exhibit will be considered in the disposition of the models.

It is presumed that the pressing need of additional space in the Patent Office building is the reason for this general clearing out of models.

An opportunity is now afforded for technical schools to secure models of interesting and well-known inventions pertaining to important industries. Inquiries should be addressed to the Commissioner of Patents, Washington, D. C.

According to the recent report of the British consul for New Caledonia, the indigenous Canaques are rapidly becoming an extinct race. Owing to the inroads of disease, more especially the more virulent maladies of phthisis and leprosy, combined with the abuse of alcoholic liquors, the natives are becoming greatly degenerated, and the people do not now number more than 17,000 souls in all. Although the disposal of spirits is forbidden to the natives, they yet obtain enormous quantities by surreptitious methods, and it kills them very quickly. Moreover, the children now born are for the most part very stunted and seldom attain adult age. The consul is of opinion that it will not be many years before the Canaques become totally extinct.

Return of Finlay's Periodic Comet.

BY PROF. WILLIAM R. BROOKS, SMITH OBSERVATORY.

Finlay's periodic comet, recently detected on its return by Koph at Heidelberg, was observed at this observatory on the morning of July 19 with the 10-inch equatorial refractor. Its position at that time was right ascension 23 hours 53 minutes 30 seconds; declination south 13 deg. 3 min. This places it on the tail of Cetus, and rather singularly, quite close to the place where the writer discovered an interesting periodic comet in July, 1889, having a period of about seven years.

Finlay's comet is at present slowly moving in a northeast direction. It is a faint telescopic object at present, slightly oval in form, with the major axis in an east and west direction, with no central condensation and no tail. The comet, however, will increase in brightness until the first week in September, when it arrives at perihelion.

This comet was discovered by Finlay at the Cape of Good Hope on September 26, 1886, and was observed for several weeks by the writer from the old Red House Observatory. The period of this comet's revolution about the sun is about six and one-half years. It was quite generally observed at its first return in 1893, but at its next return, in 1899, the comet was in such an unfavorable position that it escaped observation. At this, its third return, it is very favorably placed for observation in the eastern morning sky.

From the following ephemeris the general path of the comet may be seen, and its place projected for a little time beyond the dates here given:

	R. A.	Dec. S.
July 25	0 h. 48 m.	7 deg. 59 m.
July 29	1 h. 21 m.	5 deg. 0 m.
August 2	1 h. 56 m.	1 deg. 42 m.
		North.
August 6	2 h. 36 m.	2 deg. 35 m.

The comet, it will be seen, is moving along the back of Cetus. On August 2 it will be nearly between the stars Alpha and Mira, and early the following week in the head of that large constellation.

How Alcohol is Made from Potatoes in Germany and How the Government Controls Its Production.

The potatoes (which must be produced on the land of the proprietor) are first washed by machinery. They are then steamed and pulped, and driven through a strainer into the mash-tun where they are mixed with a small percentage of malt. The wort is then passed into the fermenting vats. Each vat is gaged, and its content marked on the outside, together with the number of the vat. The wash is left to ferment for thirty hours, and is then conveyed to the still, which is of the patent still type. On issuing from the condenser the spirit passes first through a domed glass case in which is a cup. In this cup, into which the spirit flows and from which it overflows, there float a thermometer and a hydrometer, to indicate the strength of the spirit passing. From this apparatus the spirit flows into a (Siemens) meter, fitted with an indicator which records the quantity, reduced to the standard of pure alcohol, of spirit transmitted, and from the meter the spirit passes on to the receiver.

The system of control in Germany does not require the continuous attendance of excise officers, but is compounded of (1) mechanical contrivances, (2) book entries, and (3) liability to visitation at any time.

(1) Mechanical Contrivances.—Up to the point at which the wash passes into the still, these are limited to the gaging of the vats and to the plumbing under revenue seal of all joints of the pipes leading from the vats to the still. From that point onward to the receiver every vessel is locked and sealed, and no access to the spirit can be obtained by the distiller.

In the small distilleries the meter, which no doubt is an expensive apparatus, is dispensed with, and the quantity of spirit distilled is ascertained by the excise officer from the receiver. Whether there be a meter or not, the receiver is of course under lock, and is not accessible to the distiller.

(2) Book Entries.—The regulations require entry of the quantity of materials used. But this is regarded as of little practical value, and little attention is paid to such records. It is manifest that they cannot be susceptible of any real check.

The important entries are those of the times of charging and discharging the several fermenting vats, and of the quantities of wash in each. These entries can of course be checked against the spirit found in the receiver, and on them is computed the vat tax and the distillery tax, which have to be paid by the distiller.

(3) Liability to Visitation.—It will be seen that the control under (1) and (2) provides no security against abstraction of wash from the fermenting vats. Visitation at frequent and uncertain intervals would seem to be an essential feature of the system. Visits of excise officers are even unpleasantly frequent. Whether they are so in more remote distilleries may be open to doubt.

In any case the system of control rests so heavily upon confidence that, while it may be satisfactory with a low duty on spirits and with a system of rebates of duty that makes the excise a source of profit to the smaller distiller, it could not safely be adopted where the duty is high and invariable in its incidence.

The vast majority of German agricultural distilleries are to be found in the eastern provinces of Prussia and Saxony, where the soil is poor, and the cost of conveying agricultural produce to a remunerative market is high.

In normal years the return from potatoes used in the agricultural distilleries does not exceed some $5 per ton (exclusive presumably of bonuses), and in many cases is less. The average is about $4.50 per ton.

The yield of alcohol from a ton of potatoes may be taken at about 25 gallons of pure alcohol, or about 44 proof gallons.

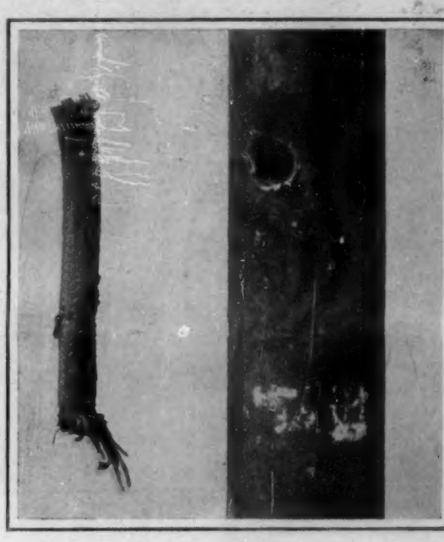
Correspondence.

Thunderstorms and Electric Wiring.

To the Editor of the SCIENTIFIC AMERICAN:

As a matter of interest and instructive value to your many readers, I am reporting an unusual and significant incident that occurred at the branch office of the SCIENTIFIC AMERICAN at Washington, D. C., during a thunderstorm on the 11th of July, 1906.

During the progress of the storm, lightning struck the electric wires that supply the office with light and power. The fuses of the various lights and fans were instantly burned out, and simultaneously therewith a torrent of water poured from the floor of the building where the wires entered, evidently flowing from the water pipe supplying the various radiators of the water-heating system, which, as is usual, had not been



HOLE BURNED IN A WATER PIPE BY LIGHTNING.

cut off for the summer months, since it is not generally considered necessary or even desirable to do so.

Careful inspection disclosed the fact that the electric wiring was close enough to the water circulation pipe to permit electricity of high voltage to jump to the fine ground connection which the water pipe afforded, and in doing so it burned a hole fully three-eighths of an inch in the water pipe, with the result above noted. I am inclosing you a section of the pipe showing the holes, of which there are two, a large and a small one, and also a piece of the wire. The torrent of water which immediately followed the discharge shows that the larger hole was the result of the discharge. The smaller one may have been produced by a ground during the removal of the pipe, as the water-heating engineer states that a flash occurred as the pipe was unscrewed preparatory to removing it, he having undertaken the work without opening the electric switch.

The lesson which the incident teaches is, first, the value of adequate lightning arresters; and second, the importance of keeping all electric wiring away from water and gas pipes. The electric wires were properly insulated, and carried by porcelain sleeves through the wooden joists of the building, but the lightning's voltage was heavy enough and the ground connection so good as to make the jump possible. If the pipe had been a gas instead of a water pipe, needless to say a fire would have occurred, which would have been difficult to control in daytime, and disastrous at night.

Washington, D. C. EDWARD W. BYRN.

A London inventor has succeeded in evolving a novel improvement upon the ordinary celluloid film used for cinematographic purposes. The pictures are taken in a spiral manner upon circular glass plates, thereby enabling a long series comprising several hundred pictures to be contained in a small space. The diameter of the plate is 15 inches, while the photographs themselves do not exceed half an inch in length. In this way it is possible to record a story lasting about four minutes upon one plate. Very slight alterations are necessary to the projecting lantern, and by revolving the plate the pictures are thrown upon the screen.

TUNNELING THE EAST RIVER.

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The furthest advanced of the tunnels now building under the East River is the Rapid Transit Subway tunnel, which comprises two tubes running from the Battery to Joralemon Street, Brooklyn. At present, the two shields of the northern tube are less than 800 feet apart, while 940 feet of rock and sand intervenes between the headings of the southern tube.

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RECENTLY COMPLETED BATTLESHIP "NEBRASKA."

The largest class of battleships of the United States navy is the "Georgia" class, which comprises five ships—the "Georgia," "Nebraska," "New Jersey," "Rhode Island," and "Virginia"; and of these the last to be completed will be the "Nebraska," which forms one of the subjects of illustration on the front page of this issue. Especial interest attaches to this ship because of the fact that she was built in the young State of Washington and at the thriving city of Seattle, which, a quarter of a century ago, was not much more than a village in size. The construction of a modern battleship calls for the highest skill and a thoroughly complete and costly shipbuilding plant, and that this great vessel, with a displacement of about fifteen thousand tons, should have been built and engined in an industrial center so modern is certainly a striking evidence of the material development of this flourishing maritime city of the extreme Northwest.

The "Nebraska" and her sisters are distinguished among battleships by the extraordinary concentration of fire of the guns of the main battery of which they are capable, being in this respect, at least in the number, if not in the weight of shell which they can deliver in any direction, unsurpassed either in our own or any other navy. This concentration is obtained by the method of mounting the 8-inch guns, of which four are carried at the great elevation of 32 feet upon the roofs of the turrets containing the 12-inch guns. The other four 8-inch are mounted amidships, 26 feet above the water, in two turrets, one on either broadside. This disposition enables the "Nebraska" to concentrate two 12-inch and six 8-inch guns directly ahead or astern, while on either broadside she can deliver the fire of four 12-inch and six 8-inch guns. In the secondary battery she carries in broadside on the gun deck twelve 6-inch rapid-fire guns, and for repelling torpedo attack she mounts twelve 3-inch, twelve 3-pounders, and eight 1-pounders. She also carries two 3-inch field guns and eight small-caliber automatic guns. Her torpedo armament is also an exceedingly powerful one, consisting of four of the new 21-inch torpedoes driven by turbine engines, of the kind described in the Scientific American of January 6, 1906, which are capable of a speed of 36 knots at a range of 1,200 yards, and a speed of 28 knots at a range of 2,500 yards.

The distribution of armor on the "Nebraska" is as follows: She carries a water-line belt which is continuous from stem to stern and varies in thickness from 11 inches amidships to 4 inches at the ends. With this is associated a deck 3 inches in thickness. The main barbettes and turrets carry 10 inches of armor and the secondary turrets 6 inches. The broadside battery is protected by side armor 6 inches in thickness which extends between the main barbettes from the top of the main armor belt to the upper deck. There are 9 inches of armor on the conning tower, and the 14-pounder guns also are protected by 2 inches of armor. The total weight of armor is 3,690 tons.

The ship is driven by twin reciprocating engines, which are designed to give a speed of 19 knots with 19,000 horse-power. The maximum coal supply is 1,700 tons.

The ship has a water-line length of 435 feet; her beam is 76 feet 2½ inches, and her maximum draft 26 feet. Her complement of officers and men will consist of 41 officers, 675 enlisted men, and 60 marines. On her builders' trial, carried out on July 2 of this year, she made a speed of 18.95 knots.

OUR LATEST BATTLESHIPS, "SOUTH CAROLINA" AND "MICHIGAN."

The recent letting of contracts for the construction of the two new battleships "South Carolina" and "Michigan" to the Cramp Ship and Engine Building Company and to the New York Shipbuilding Company, has brought these two formidable vessels into special prominence, and a description of the leading features of their design will be timely.

Particular interest attaches to these vessels because of the fact that they are the first battleships to be designed by our Navy Department subsequently to the conclusion of the Russo-Japanese war, and that in their design they embody the valuable experience gathered during that great conflict. The most marked feature is the complete elimination of the intermediate battery, which in our earlier ships consisted of a large number of 5-inch, 6-inch, 7-inch, or 8-inch guns. The customary number of guns in the main battery has been doubled, so that instead of four 12-inch carried in two turrets, the new ships have eight such guns mounted in four turrets. The numerous battery of small rapid-fire guns is retained, since its service will always be necessary for the repelling of torpedo-boat attack. In length and displacement the new vessels are approximately the same as their predecessors, the "Louisiana" and "Connecticut," though with greater beam and ½ knot more speed. They are also more effectively armored than those ships, and in fighting power they are believed to be vastly superior; that is to say, if the new theories as to the probable tactics of future naval conflicts prove to be correct.

The general dimensions of the vessels are as follows: The length on the load water line will be 450 feet; the breadth is greatly increased over that of the "Connecticut," being 80 feet 2⅝ inches. The mean draft at trial displacement must not exceed 24 feet 6 inches, on which draft the displacement must be 16,000 tons.

The General Appearance of the New Battleships.—The two ships when completed will, in appearance, be distinctly different from any of our other battleships. The most noticeable feature, of course, will be the four 12-inch turrets and their guns, mounted in pairs on the axial line of the ship, two forward and two aft of the superstructure. The doubling up in the number of 12-inch turrets, and the placing of them one ahead of the other, has necessarily shortened the length of the superstructure, and crowded the masts, smokestacks, etc., into a shorter space amidships, a fact which is readily noticeable on looking at the engraving of the new ships. In order to save weight the freeboard of the ship has been reduced by the depth of one deck, or about 8 feet, from aft of the superstructure to the stern. Hence the "South Carolina" and "Michigan," while they will have the same freeboard forward as the "Connecticut" and "Louisiana," will have a lower freeboard by about 8 feet throughout the after third of the vessels' length. The most forward pair of 12-inch guns is carried at about the same height as the 12-inch guns of the "Connecticut," or say about 24 feet above the water line. Immediately abaft of these is the second pair of forward 12-inch guns, which are so mounted as to fire clear across the roof of the forward turret, the barbette for these guns being increased in height by about 8 feet in order to give the requisite elevation. The guns have the great command of 32 feet above the water line. The after pair of turrets with their four guns are mounted similarly, although at an elevation in each case 8 feet lower than that of the forward guns.

The shortening of the superstructure has been accompanied also by a moving of the two military masts toward the center of the vessel, and a distinct novelty is seen in the placing of these masts, not on the longitudinal axis of the ship, but diagonally, the forward mast being moved over to starboard and the mainmast to port. Advantage is taken of this new position to mount the boat cranes on these masts, with, of course, a considerable saving of weight.

Armor and Armor Protection.—The armor protection has been exceedingly well worked out, and forms one of the most commendable characteristics of these vessels. Its most important element is a water-line belt 8 feet in width, and more than 300 feet in length. The midship portion of the belt varies in thickness from 11 inches at the top to 9 inches at the bottom, while that in the wake of the magazine is 12 inches thick at the top and 10 inches at the bottom. The casemate side armor above this water-line belt is nearly 300 feet long; it will be 8 inches thick at the top, 10 inches at the bottom, and will be about 8 feet 1 inch wide amidships. This is a casemate protection which, in extent and in thickness, has never been approached in our previous battleships. Triangular athwartship armor, 10 inches thick, will be fitted at the after end of the belt armor, between the slope of the protective deck and the extension of the flat protective deck. Also an athwartship armor bulkhead, extending entirely across the ship between the upper platform and the protective deck, will be fitted at the forward end of belt. This will be 10 inches thick throughout. Furthermore, an athwartship casemate armor bulkhead will be fitted between the shell plating and the barbettes between the berth and main decks at forward and after ends of casemates; this will be 8 inches in thickness throughout.

Barbette Armor.—The forward barbette extends from the protective deck to about 4 feet above the upper deck, and it varies in thickness from 10 inches to 8 inches, according as it is flanked by the side armor of the ship. The after forward barbette extends to a height of about 12 feet above the upper deck, and carries the same general thickness of armor. The forward after barbette extends from the protective deck to 12 feet above the main deck, and the barbette aft of this extends from the protective deck to 4 feet above the main deck. In the case of each of the four turrets, the port plate will be 12 inches in thickness, the rear and side plates 8 inches, and the top plates 2½ inches in thickness.

The vessels will be propelled by vertical twin-screw four-cylinder triple-expansion engines of 16,000 horse-power. The steam pressure will be 265 pounds in the high-pressure valve chest, and the revolutions per minute will be 125. Steam will be supplied by twelve water-tube boilers fitted with superheaters, carried in three water-tight compartments. The vessels will be lighted throughout by electricity, and the operation of the turrets, ammunition hoists, and, indeed, most of the mechanical work throughout the ship, will be performed by electrical power. The coal bunkers will be arranged with a direct reference to the rapid and efficient supply of coal to the fire rooms, and with especial reference to efficient water-tight subdivision of the vessel. There will be provided for coaling the ships not less than five winches, ten booms, wire spans, with the necessary whips at all the usual chutes and other openings, special provision having been made for the rapid coaling of the vessels. There will be a bridge both forward and aft, built according to the latest practice. The masts will be fitted with searchlight platforms, and arranged for wireless telegraphy. There will be one signal yard on each mast, a battle gaff on the mainmast, and a lookout platform on the foremast.

Distribution of Weight.—It is instructive to study the distribution of weights in these new vessels; the guns, mounts, ammunition, and ordnance stores will represent about 7 per cent of the trial displacement; the motive power, including engines, boilers, piping, etc., about 10 per cent, and the total armor protection reaches the great figure of more than 25 per cent of the trial displacement.

Concentration of Fire.—It will be seen at once that by arranging the two extra pairs of 12-inch guns at a sufficient height to enable them to be fired across the roofs of the adjoining turrets, the theoretical all-round concentration of fire is remarkably powerful. Forward, when in pursuit of the enemy, or when fighting in the end-on position, it will be possible to concentrate four 12-inch guns, which is double the number that can be trained in a similar direction on the "Connecticut" and "Louisiana." Aft there is a similar concentration of four 12-inch guns, while on the beam these ships will be able to train eight 12-inch guns.

In a previous issue of the Scientific American we have criticised this method of placing the armament, on the ground that previous experience with the "Oregon" and her class showed that if heavy guns were fired across the roofs of the adjoining turrets, the work of the gun crews in these turrets would be seriously interfered with. We are informed, however, that particular attention has been given by the Navy Department to this difficulty, and that by virtue of the improved sighting ports and the closely-fitting port shields employed, and other arrangements, it will be possible, in an emergency, to fire any of these 12-inch guns in any position of training without serious interference with the work of the other gun crews. If this should prove to be the case, our Navy Department will be the subject for congratulation on having produced, in proportion to their displacement, by far the most powerful fighting ships built or building in the world to-day; for it must be remembered that these vessels are of but 16,000 tons displacement, while the latest battleship designs of other governments are of from 18,000 to 19,000 tons displacement.

There are many novel details of construction in these vessels, which, for obvious reasons, it is not expedient to make public at the present time—such, for instance, as the more complete water-tight subdivision of the vessel, and provision against heeling due to damage in action; and the protection of the vessels' longitudinal strength when damaged by gun fire, the provision of adequate longitudinal strength being particularly important in view of the concentration of the weight of the barbettes and heavy guns so near the extremities of the ship.

Distribution of Patent Office Models.

It appears, according to an act of Congress passed on June 22, 1906, the Secretary of the Interior is authorized to dispose of a part or of all the model exhibit of the Patent Office, either by sale, gift, or otherwise. Acting Commissioner E. C. Moore has issued a notice to the effect that immediate requests from polytechnic schools and colleges having technical courses for portions of the exhibit will be considered in the disposition of the models.

It is presumed that the pressing need of additional space in the Patent Office building is the reason for this general clearing out of models.

An opportunity is now afforded for technical schools to secure models of interesting and well-known inventions pertaining to important industries. Inquiries should be addressed to the Commissioner of Patents, Washington, D. C.

According to the recent report of the British consul for New Caledonia, the indigenous Canaques are rapidly becoming an extinct race. Owing to the inroads of disease, more especially the more virulent maladies of phthisis and leprosy, combined with the abuse of alcoholic liquors, the natives are becoming greatly degenerated, and the people do not now number more than 17,000 souls in all. Although the disposal of spirits is forbidden to the natives, they yet obtain enormous quantities by surreptitious methods, and it kills them very quickly. Moreover, the children now born are for the most part very stunted and seldom attain adult age. The consul is of opinion that it will not be many years before the Canaques become totally extinct.

Return of Finlay's Periodic Comet.

BY PROF. WILLIAM R. BROOKS, SMITH OBSERVATORY.

Finlay's periodic comet, recently detected on its return by Koph at Heidelberg, was observed at this observatory on the morning of July 19 with the 10-inch equatorial refractor. Its position at that time was right ascension 23 hours 53 minutes 30 seconds; declination south 13 deg. 3 min. This places it on the tail of Cetus, and rather singularly, quite close to the place where the writer discovered an interesting periodic comet in July, 1889, having a period of about seven years.

Finlay's comet is at present slowly moving in a northeast direction. It is a faint telescopic object at present, slightly oval in form, with the major axis in an east and west direction, with no central condensation and no tail. The comet, however, will increase in brightness until the first week in September, when it arrives at perihelion.

This comet was discovered by Finlay at the Cape of Good Hope on September 26, 1886, and was observed for several weeks by the writer from the old Red House Observatory. The period of this comet's revolution about the sun is about six and one-half years. It was quite generally observed at its first return in 1893, but at its next return, in 1899, the comet was in such an unfavorable position that it escaped observation. At this, its third return, it is very favorably placed for observation in the eastern morning sky.

From the following ephemeris the general path of the comet may be seen, and its place projected for a little time beyond the dates here given:

	R. A.	Dec. S.
July 25	0 h. 48 m.	7 deg. 59 m.
July 29	1 h. 21 m.	5 deg. 0 m.
August 2	1 h. 56 m.	1 deg. 42 m.
		North.
August 6	2 h. 36 m.	2 deg. 35 m.

The comet, it will be seen, is moving along the back of Cetus. On August 2 it will be nearly between the stars Alpha and Mira, and early the following week in the head of that large constellation.

How Alcohol is Made from Potatoes in Germany and How the Government Controls Its Production.

The potatoes (which must be produced on the land of the proprietor) are first washed by machinery. They are then steamed and pulped, and driven through a strainer into the mash-tun where they are mixed with a small percentage of malt. The wort is then passed into the fermenting vats. Each vat is gaged, and its content marked on the outside, together with the number of the vat. The wash is left to ferment for thirty hours, and is then conveyed to the still, which is of the patent still type. On issuing from the condenser the spirit passes first through a domed glass case in which is a cup. In this cup, into which the spirit flows and from which it overflows, there float a thermometer and a hydrometer, to indicate the strength of the spirit passing. From this apparatus the spirit flows into a (Siemens) meter, fitted with an indicator which records the quantity, reduced to the standard of pure alcohol, of spirit transmitted, and from the meter the spirit passes on to the receiver.

The system of control in Germany does not require the continuous attendance of excise officers, but is compounded of (1) mechanical contrivances, (2) book entries, and (3) liability to visitation at any time.

(1) Mechanical Contrivances.—Up to the point at which the wash passes into the still, these are limited to the gaging of the vats and to the plumbing under revenue seal of all joints of the pipes leading from the vats to the still. From that point onward to the receiver every vessel is locked and sealed, and no access to the spirit can be obtained by the distiller.

In the small distilleries the meter, which no doubt is an expensive apparatus, is dispensed with, and the quantity of spirit distilled is ascertained by the excise officer from the receiver. Whether there be a meter or not, the receiver is of course under lock, and is not accessible to the distiller.

(2) Book Entries.—The regulations require entry of the quantity of materials used. But this is regarded as of little practical value, and little attention is paid to such records. It is manifest that they cannot be susceptible of any real check.

The important entries are those of the times of charging and discharging the several fermenting vats, and of the quantities of wash in each. These entries can of course be checked against the spirit found in the receiver, and on them is computed the vat tax and the distillery tax, which have to be paid by the distiller.

(3) Liability to Visitation.—It will be seen that the control under (1) and (2) provides no security against abstraction of wash from the fermenting vats. Visitation at frequent and uncertain intervals would seem to be an essential feature of the system. Visits of excise officers are even unpleasantly frequent. Whether they are so in more remote distilleries may be open to doubt.

In any case the system of control rests so heavily upon confidence that, while it may be satisfactory with a low duty on spirits and with a system of rebates of duty that makes the excise a source of profit to the smaller distiller, it could not safely be adopted where the duty is high and invariable in its incidence.

The vast majority of German agricultural distilleries are to be found in the eastern provinces of Prussia and Saxony, where the soil is poor, and the cost of conveying agricultural produce to a remunerative market is high.

In normal years the return from potatoes used in the agricultural distilleries does not exceed some $5 per ton (exclusive presumably of bonuses), and in many cases is less. The average is about $4.50 per ton.

The yield of alcohol from a ton of potatoes may be taken at about 25 gallons of pure alcohol, or about 44 proof gallons.

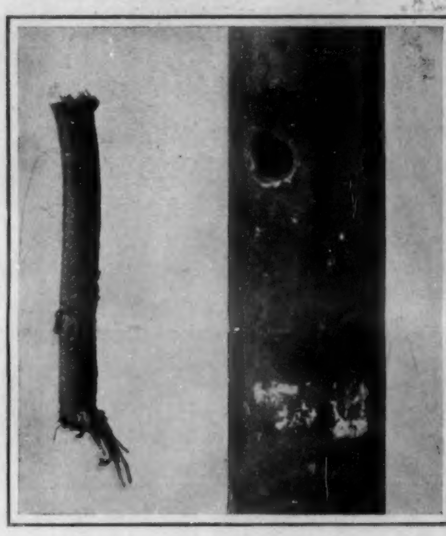
Correspondence.

Thunderstorms and Electric Wiring.

To the Editor of the SCIENTIFIC AMERICAN:

As a matter of interest and instructive value to your many readers, I am reporting an unusual and significant incident that occurred at the branch office of the SCIENTIFIC AMERICAN at Washington, D. C., during a thunderstorm on the 11th of July, 1906.

During the progress of the storm, lightning struck the electric wires that supply the office with light and power. The fuses of the various lights and fans were instantly burned out, and simultaneously therewith a torrent of water poured from the floor of the building where the wires entered, evidently flowing from the water pipe supplying the various radiators of the water-heating system, which, as is usual, had not been



HOLE BURNED IN A WATER PIPE BY LIGHTNING.

cut off for the summer months, since it is not generally considered necessary or even desirable to do so.

Careful inspection disclosed the fact that the electric wiring was close enough to the water circulation pipe to permit electricity of high voltage to jump to the fine ground connection which the water pipe afforded, and in doing so it burned a hole fully three-eighths of an inch in the water pipe, with the result above noted. I am inclosing you a section of the pipe showing the holes, of which there are two, a large and a small one, and also a piece of the wire. The torrent of water which immediately followed the discharge shows that the larger hole was the result of the discharge. The smaller one may have been produced by a ground during the removal of the pipe, as the water-heating engineer states that a flash occurred as the pipe was unscrewed preparatory to removing it, he having undertaken the work without opening the electric switch.

The lesson which the incident teaches is, first, the value of adequate lightning arresters; and second, the importance of keeping all electric wiring away from water and gas pipes. The electric wires were properly insulated, and carried by porcelain sleeves through the wooden joists of the building, but the lightning's voltage was heavy enough and the ground connection so good as to make the jump possible. If the pipe had been a gas instead of a water pipe, needless to say a fire would have occurred, which would have been difficult to control in daytime, and disastrous at night.

Washington, D. C. EDWARD W. BYRN.

A London inventor has succeeded in evolving a novel improvement upon the ordinary celluloid film used for cinematographic purposes. The pictures are taken in a spiral manner upon circular glass plates, thereby enabling a long series comprising several hundred pictures to be contained in a small space. The diameter of the plate is 15 inches, while the photographs themselves do not exceed half an inch in length. In this way it is possible to record a story lasting about four minutes upon one plate. Very slight alterations are necessary to the projecting lantern, and by revolving the plate the pictures are thrown upon the screen.

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Strictly speaking, then, this work was not of a subaqueous character, so that the true history of subaqueous tunneling in soft ground properly begins with the Thames tunnel, which was built about eighty years ago. Since then, a dozen or more such tunnels have been built, but despite the experience they afforded, there is still a great deal to learn on the subject. Each tunnel has its own individual characteristics, and offers its own puzzling problems. For example, three different lines of tunnels are now being built under the East River, two of which are within a half mile of each other, yet the material through which they are being cut is different in each case and, furthermore, is of an entirely different character from that encountered in the Harlem River and the Hudson River. Not only do these tunnels differ in the nature of the soil and rock through which they pass, but also in their depth below the surface of the water and in their size, which variations govern the air pressure necessary in the tubes and working chambers and introduce complications that do not appear at a casual glance.

The furthest advanced of the tunnels now building under the East River is the Rapid Transit Subway tunnel, which comprises two tubes running from the Battery to Joralemon Street, Brooklyn. At present, the two shields of the northern tube are less than 800 feet apart, while 940 feet of rock and sand intervenes between the headings of the southern tube.

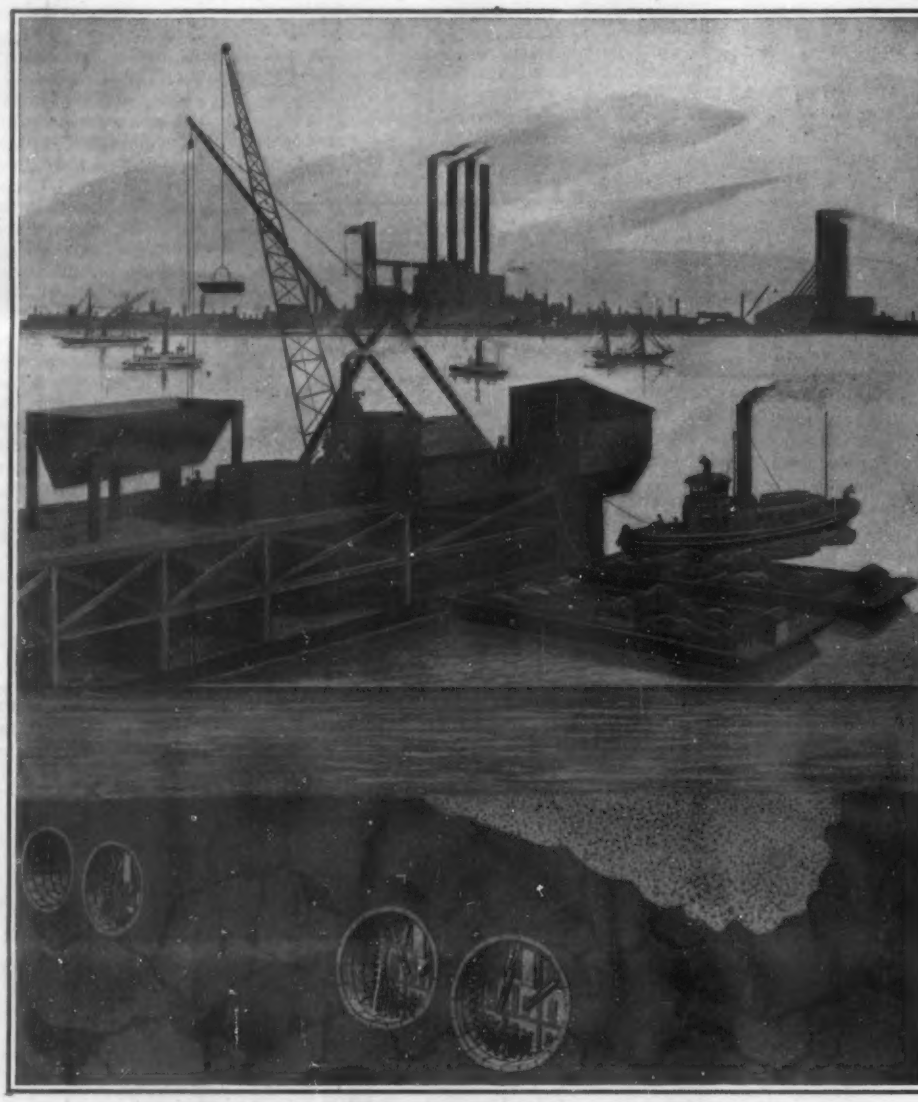
Before commencing these tubes, careful borings were made in the river bed along the line of the tunnel. At first, wash borings were made, these consisting in sinking a tube into the river bed with a water jet until it struck rock. The mud and sediment in the tube indicated the nature of the materials of which the river bed is composed. A large number of these borings were made. They might be called soundings rather than borings, because they did not penetrate the rock but merely indicated the depth below water level at which rock was encountered. Such borings in themselves are apt to be quite misleading, because only the surface of the rock is indicated and there is no way of determining whether the rock is solid or merely a large bowlder. Only by diamond drill borings into the rock itself carried below the depth of the tunnel floor, is it possible to make an accurate estimate of the conditions which will be met when driving a tunnel. With a diamond drill a core is cut out which serves as an actual sample of the rock or other materials encountered; consequently it was decided to verify the wash boring statistics with diamond drill borings. But the driving of a diamond drill boring from the surface of a body of water subject to such tidal currents as prevail in the East River is no small task. In borings of this type it is imperative that the drill be kept in perfect vertical alignment. This necessitated the building of a firm, stationary platform in the river wherever a boring was to be made. A pile driver was used to carry the drill-operating mechanism, and the working platform was supported on piles driven into the river bed. Much difficulty was experienced in maintaining the working platform, as barges in the river were frequently swung by the tide against the piles, knocking them down or out of alignment. Several drills were lost by accidents of this character. But results proved that the precaution of verifying the wash borings was well taken. The original profile showed rock near the Brooklyn shore, but when the rock was drilled, it was found to be merely a large bowlder beneath which, in the line of the tunnel, there was nothing but soft material. Discrepancies were also found in other places, so that the true profile which we publish here differs very much from the original one based on wash borings.

The rock profile along the New York and Long Island Railroad tunnel at 42d Street, popularly known as the Belmont tunnel, was also based on diamond drill borings and a number of wash borings. A novel method of establishing working platforms for the borings was used. The water here was deeper than at the Battery and pile foundations were out of the question. Instead, a steel tower 68 feet high was procured, one which had

been used in raising the girders of the 72d Regiment Armory; the tower was anchored at the desired places and a platform at the top provided a substantial working base. The tower weighed about five tons and a pile driver was used for lifting it and moving it about. The anchors were attached by cables both to the top and to the bottom of the tower, and by means of tackle, the anchor lines were drawn in or let out to adjust the position of the working platform. The tide at this part of the river has a velocity of fully five miles an hour and this speed is often greatly increased by the action of the wind. As may well be imagined, the difficulty of properly anchoring the tower was great. Three times the tower was overthrown by the strong current before it could be properly anchored. Eventually the task was accomplished, however, and we illustrate herewith the profile taken from these borings and which has so far proved to be correct.

In laying out the course of the tunnels of the Pennsylvania, New York and Long Island Railroad at 32d and 33d Streets, no diamond drill borings were made in the river, but wash borings were made about one hundred feet apart along the line of each pair of tunnels. However, the precaution was taken of blasting the rock wherever it was encountered. If the rock were merely a bowlder, it would be shattered by the blast, permitting the boring to be carried down further. If the boring could not be continued, it indicated solid rock or at least a bowlder so large as to present about the same difficulties as would be offered by solid rock.

The tunnel at the Battery has been built through rock for a distance of about two thousand feet from the bulkhead line at the Battery. No shield was necessary in this section and the excavation was carried on under normal air pressure. One of our illustrations shows the method of lining this portion of the tunnel, the hydraulic erectors being carried on a crane traveling along the spring line of the tunnel. Just now the tunnel is emerging from the rock and a shield has been erected. On the Brooklyn side the tubes were pushed through soft mud and sand, but at present writing they have entered a reef at the center of the river. Very rapid progress was made through the soft material. A moderate pneumatic pressure was used, so that the material entering the shield near the floor was very fluid; as a result the shield was undermined and sank a few inches. This threw the tunnel out of grade and gave rise to the recent hysterical reports that the tunnel lining had buckled under the great weight of the river above. Except for this error which has now been corrected, no difficulties have been encountered. Most of the material which now lies between the headings is firm sand, and no doubt in a very short time this will be penetrated.



Section Taken Across the Pennsylvania Tunnels on the Manhattan Side.

So far, very little has been published about the Belmont tunnel. Through the courtesy of the chief engineer, Mr. St. John Clarke, and the chief assistant engineer, Mr. Allan Appleton Robbins, we have recently been accorded an opportunity to inspect the progress of this work. The tunnel comprises two tubes which will have a finished diameter of 15½ feet. They are being driven from four shafts, one at each side of the river, one at Blackwell's Island reef in the center of the river, and the fourth at Third Avenue and 42d Street. The work has been attacked in each direction from each shaft, making sixteen headings altogether. The tunnels have been carried about 700 feet through solid rock in each direction from the Third Avenue shaft. They will be extended westward as far as Park Avenue fully 40 feet below the present Subway. What terminal will be reached is unknown, but doubtless connections will be made with the New York Central Railroad. The shaft in the center of the river is located in a reef which is submerged except at high tide. Here two steel cylinders were used which were sunk under pneumatic pressure to a depth of 10 feet in the rock. A large island, probably 400 feet long by 100 feet wide, has been built up on this reef. At the present, work has progressed about 150 feet each way from the bottom of this shaft. As the tubes are run through hard rock, no pneumatic pressure has been found necessary. On the Manhattan side, the tubes have been driven to a distance of 100 feet beyond the bulkhead line. Pneumatic pressure is here used because the work is carried on in a decayed rock which is somewhat seamy and treacherous. Normally the material holds the pneumatic pressure very well—in fact, almost too well, because it is constantly necessary to blow off some of the compressed air to provide fresh air for the workingmen. Good progress is being made through this material, as it is almost soft enough to be removed with pick and shovel. On the Long Island side, the excavation has proceeded to a distance of 400 feet beyond the bulkhead line, and is about to break out of the rock into softer material. At the present rate of progress, the tunnels should be completed in the course of a few months.

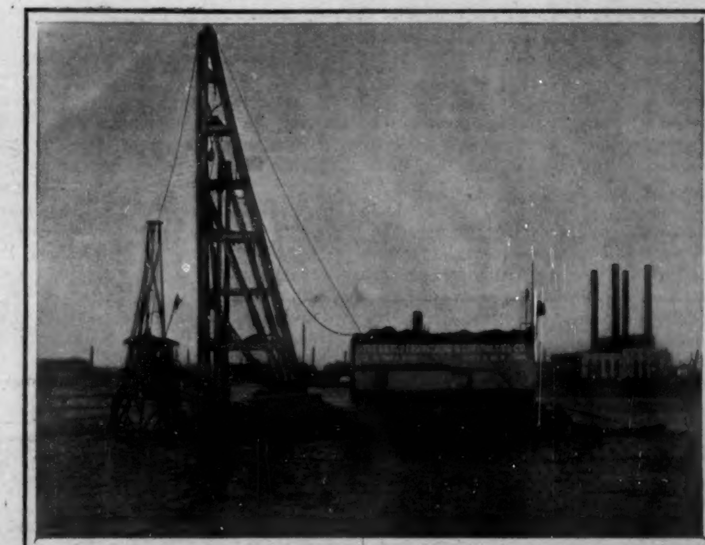
The progress of the Pennsylvania tunnels has been recently given in these columns. In some respects, this enterprise presents the most difficult subaqueous work ever undertaken. The diameter of the tubes, of which there are four, is 23 feet. This is but 4 feet less than the diameter of the Blackwall tunnel, which was built by the same contractors, Messrs. S. Pearson & Son. Two of the tubes on the Manhattan side have been carried out of the rock and are being pushed forward through quicksand. In this material the shield is constantly sinking, and in order to maintain the

Portion of the Subway Tunnel, Showing Method of Erecting the Lining.

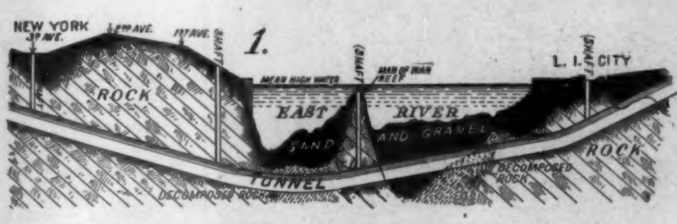
The Traveling Crane Used in the Subway Tunnel.

TUNNELING THE EAST RIVER.

grade of the tunnel, the lower jacks of the shield are kept 2 to 6 inches in advance of the upper ones. The shield is thus tilted upward and the tunnel lining at the tail of the shield is built at about grade. No settlement takes place except where excavation is being carried on. In one of our illustrations, we show a shield of the type used. Eight of these shields are in service, four working from the Manhattan side and four from the Long Island side. It will be observed, in the front view of this shield, that a series of plates are being erected along the upper semi-circumference. These form a hood which is moved out ahead of the shields proper into the soft material as it is excavated. Two horizontal working platforms are shown in the illustration, and these are also adapted to be moved forward together with the vertical partitions. When working through soft material, the front of each working chamber, of which there are nine, is inclosed by shutters to prevent the quicksand from flowing in and overwhelming the men. Owing to the movable platforms and hood, the work can progress separately in each chamber, the hood plates being gradually moved forward as the material is excavated, then the shutters, the partitions, and the platforms. After the excavation has been carried to a distance of 2½ feet beyond the normal cutting edge of the shield, the latter is pushed forward by hydraulic jacks, overtaking the movable members and permitting a ring of the tunnel lining to be erected. One of our diagrams is a section of the shield, showing the double diaphragm used. The primary object of this was to serve as an air lock between the front and the rear of the shield, so that a higher working pressure could be maintained in front of the shield than at the rear, thus permitting the work of carrying off the spoil to be done in comparatively low pressure. It will be observed that muck chutes pass through the two diaphragms and these are provided with doors, permitting the spoil to be locked through. In practice, however, it is found that the inconvenience and expense of maintaining this difference in air pressure were greater than the advantages it offered. The air pressure at present maintained varies from 32 to 35 pounds per square inch above normal. Owing to the large diameter of the tubes, escape of air is inevitable. An escape of five thousand cubic feet per minute is not considered excessive; however, when more than this amount flows out, scows are towed over the leak and clay is deposited on the river bed at this point. Some difficulty has been experienced, owing to the fact that the air occasionally finds its way through some crevice to a considerable distance beyond the end of the tube. However, only one accident of a really serious nature has occurred. Considering the stupendous undertaking of simultaneously driving four tunnels of so large a section through material of so treacherous a character, the results so far obtained are remarkably creditable.

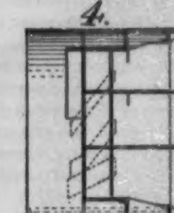


Making a Diamond Drill Boring from the Sunken Tower.



Profile of the New York and Long Island Railroad Tunnel.

Course of the Pennsylvania Tubes.



Section of the Shield.

Profile of the Rapid Transit Subway Tunnel.

"Toe-Nailing."

The novice at carpenter work who experiences difficulty in driving a nail straight, will probably be at a loss to understand why any one should go to the trouble of inventing a nail which would bend as it sinks into the wood, but such an article has been made the subject of a recent patent. This nail is designed especially for the fastening of abutting pieces of wood together, in the manner technically known as "toe-nailing." In this operation it is necessary to drive the nail at such an angle that it will enter the second board against which the first one abuts, so that the two will be held together. The difficulty in the use of the ordinary nail for this purpose, is to drive it at just the right angle, so that it will take a proper hold of both pieces. With the new nail this is accomplished by making use of a peculiar plow-shaped end, which causes the nail to describe an arc as it passes through the wood.

The Current Supplement.

The current SUPPLEMENT, No. 1596, contains an unusual number of instructive articles. Mr. Frank C. Perkins describes some novel electrically-operated coke-drawing machines. The status of the turbine as applied to marine work has been taken by Mr. Herbert C. Sadler as his subject. The Use of Alcohol as a Fuel for Gas Engines is the title of perhaps the most important article in the issue—important because of the passage of the bill which removes the tax from denaturized alcohol. Excellent diagrams accompany the article, showing various forms of alcohol carbureters and engines. Many dark spots in the Milky Way seem to be openings or holes in that wonderful zone of stars. These are described and commented upon by J. E. Gore. Another series of valuable alloys is published. Prof. H. M. Hough writes on the relative corrosion of wrought iron and steel. A ratchet-and-pawl-propelled steam truck, with crankless engine and gearless drive, is described and illustrated. The ultramicroscope is an apparatus which in one respect very greatly increases the power of the most perfect of ordinary microscopes. How it accomplishes this is described in a well-illustrated and exhaustive article.

Front View of the Shield Used in the Pennsylvania Tunnel.

Tail of a Pennsylvania Shield, Showing a Portion of Tunnel Lining Temporarily Erected.

TUNNELING THE EAST RIVER.

AN AUTOMOBILE FOR RURAL FREE DELIVERY.

BY WALDON FAWCETT.

For several years past rural mail carriers in New England and certain other sections of the country which are favored with exceptionally good roads have employed automobiles in making postal deliveries and collections in country districts. A number of factors, however, operated against a general sanction by the Post Office Department for the use of the horseless vehicles by rural postmen as a class. These influences included the varying conditions of the roads in many parts of the United States; physical aspects of the country; unbridged streams; defective mechanism in the construction of some of the automobiles offered for such service, and ignorance on the part of many rural carriers in regard to the operation of the motor cars. Of late, however, conditions have appeared to be ripe for a much more general utilization of automobiles in this branch of the postal service, and action has been taken accordingly.

Upon the recommendation of Fourth Assistant Postmaster-General De Graw, who has general jurisdiction over rural free delivery, Postmaster-General Cortelyou has issued an order sanctioning the use of automobiles and motor cycles where the roads are maintained in good condition and the physical aspects of the country are favorable to the use of such cars. As a precautionary measure, the Department reserves the right to require rural carriers to discontinue the use of horseless vehicles, and resume the service of their routes in ordinary vehicles, if complaint is made of unsatisfactory service arising from the use of autos.

Distributing Mail in the New Rural Free Delivery Automobile.

The chief circumstance which induced the government to adopt this new policy of encouragement in the use of automobiles in rural free delivery was found in the recent manufacture of a motor car designed expressly for the rural postal service, and which it is claimed not only remedies the defects found in the earlier motor cars tested in connection with rural mail carrying, but can also be furnished to country postmen at a price in the neighborhood of \$400 each, or little more than the average country postman might be called upon to expend for a team of horses and a vehicle, with which to traverse his route under the old conditions.

Photos copyright 1906 by Waldon Fawcett.

New Automobile for Rural Free Delivery, Now Undergoing Government Tests.

AN AUTOMOBILE FOR RURAL FREE DELIVERY.

The new automobile during the past few weeks has been subjected to the best of all tests — practical service on various rural mail routes in the States of Virginia and Maryland. These demonstrations will be repeated some six months hence, in order that the government officials may have an opportunity to observe the behavior of the vehicle on roads choked with snow and in the face of winter conditions in general.

This unique postal motor car is an Orient friction-drive buckboard, with a seating capacity of two persons. It is fitted with a mackintosh buggy top, and on the forward part of the body is mounted a case divided into pigeon-hole compartments for holding the mail. The weight of the car is 600 pounds, and with a carrier and the maximum quantity of mail matter to be transported on any trip, the gross weight would probably be considerably less than 900 pounds. The maximum speed of the car is 25 miles, and the normal speed on ordinary roads is 15 to 18 miles per hour. The manufacturers claim that the hill-climbing power of this type of car exceeds that of any other motor car, regardless of horse-power or weight, and in actual tests machines of this design have ascended grades of 32 per cent.

The propulsive power is furnished by a single-cylinder, air-cooled motor of four horse-power. A three-blade fiber fan mounted on the front of the cylinder assists in the air-cooling properties. The motor consumes about one gallon of gasoline per thirty-five miles, and the capacity of the gasoline tank is three and one-half gallons. The average length of a rural free delivery route is twenty-four miles, and the introduction of an automobile on any route, with its consequent saving of time, makes necessary an entire rearrangement of the carrier's schedule.

Seasickness and Equilibration of the Eyes.

Many people have no doubt noticed, when traveling by sea, that the motion of the ship could be *seen* very distinctly, even when there were no hanging lamps, draperies, or fixed points, such as the horizon or clouds, within range of sight.

Some may think that seeing the motion in this way is due to the imagination receiving its suggestions from the motion of the internal organs, and especially the stomach, for I am here supposing the body to be held perfectly rigid.

From observations which I have recently made it seems evident to me that the cause for seeing the motion is entirely different.

In the first place, you can always see the motion a fraction of a second before you begin to feel it. In the second place, you cannot see a perfectly horizontal motion or a gentle vertical (heaving) motion. In the third place, watching a fixed point close to you, such as a pattern on a carpet, when the ship is pitching and rolling, is far more tiring to the eyesight than when the ship is motionless or running perfectly steadily. All this points to the appearance being due to a true relative motion of the eyes to the ship.

The eyes are suspended in their muscular settings, much in the same way as are ships' compasses in their binnacles. The eyes are, furthermore, perfectly balanced, so as to make their muscular displacements as little tiring as possible. In their normal position, the pull of gravity is exerted vertically through their centers, and the muscular mechanism is compensated for gravity.

Any angular change of position will displace the eyes just as it displaces the stomach, excepting that the eyes, being a great deal more sensitively suspended, will register the displacements more quickly. It is not, however, the motion of the eyes which strains the eyesight, but the act of resisting this motion.

If, with your eyes shut, you attempt to fix the mental representation of a point, which a moment previously you were watching with eyes wide open, you will find that, after one or two motions of the ship, the bodily feeling will precede any visual sensation which your imagination can conjure up. The imaginary point is no longer fixed, but follows the eyes as they let themselves go to the motions of the ship. No strain of the eyesight is caused by a muscular resistance, and the displacements, while felt, can no longer be seen.—Alfred Sang in Nature.

The deepest colliery shaft in Germany at the present time is the No. 3 shaft of the Morgenstern Colliery at Zwickau, which is 1,082 meters deep.

A MECHANICAL ELECTRO-PLATING APPARATUS.

BY A. FREDERICK COLLINS.

It is well known that before articles can be electroplated they must be cleaned, both mechanically and chemically. Prior to the invention of the arrangement here described and illustrated, it has been the practice to place the articles in a jar or sink, or to string them on wires, when they are carried through a concentrated solution of lye, then cyanide and water, or a mixture of suitable acids, as the case may be, and then transferred to an ordinary plating tank.

The cost of plating small articles by this method was not only excessive, but the work done was far from good. These features led to the employment of plating barrels. The merits of plating barrels were not to be ignored, whatever their disadvantages might be; for by their use much time was saved. It was therefore unfortunate that the plating barrel had, in almost every case, to be abandoned, owing to imperfections.

In the Hanson & Van Winkle mechanical electroplating apparatus these defects have been eliminated, marked improvements made, and a machine evolved that is commercially perfect. Batches of the very smallest articles, such as screws or pins, or of pieces as large as stove legs and pulley wheels, may be plated with nickel, brass, copper, or zinc, entirely doing away with the handling, labor, and cost of wire formerly used in stringing.

Briefly, the apparatus consists of a plating bath in which a cylindrical or other shaped barrel made of wickerwork or any suitable material, is completely submerged. In this barrel is then placed the work to be plated, making contact with the cathode terminals, which are suspended from the conducting shaft inside the barrel by means of short sections of chains. The barrel is revolved by a pulley outside of the tank, and while the deposition of the metal on the articles is taking place, the latter are tumbled about, until by the time the work is completed, they have taken on a comparatively bright polish.

In one of the earlier forms of the apparatus, the perforated barrel submerged in the electrolytic bath was rotated by a belted pulley immersed in the solution. Another trouble arose from the metal that was deposited upon the framework and other metal parts in the solution; a third fault was the inconvenience of getting the barrel in and out of the solution.

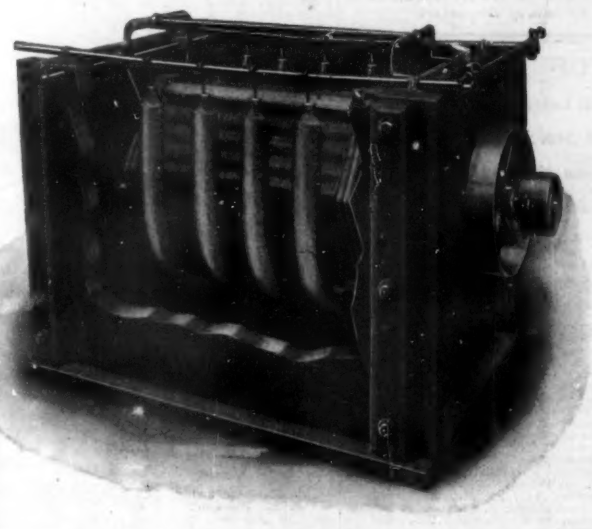
In the new form of apparatus the working parts have been greatly simplified, and the exposed surfaces reduced to a minimum. This has been done by placing the pulleys outside the tank, the shaft passing through one end of the latter, while the metal portions sustaining and rotating the barrel are covered with hard rubber.

The general arrangement of this electro-mechanical plater is shown in perspective in one of the illustrations, with the side cut away, so that the details of construction are more clearly brought out. The barrels are of various sizes, and are made cylindrical, hexagonal, or octagonal, and of wickerwork, wood, hard rubber, celluloid, etc., according to the character of the work to be plated. It is possible to handle pins, shoe nails, and other small pointed articles by using a barrel with sufficiently small perforations to retain them.

Though the drive is from the outside, which avoids the use of belts running in the solution, yet the plating barrel is removable at any time without throwing off the belt, or in any way interfering with the drive. This is accomplished through the medium of a feather and clutch just inside the tank; that is, the end of the pulley shaft is slotted, and the end of the shaft to which the basket is attached slips into it, so that when they are thus joined together both revolve, yet permitting the basket or barrel to be lifted out of the solution, and replaced easily and quickly.

The electrical contacts between the terminals of the dynamo or other source of current and the cathode terminals are large and ample, the current to the shaft

or work-rod carrying the flexible cathode contacts being made through the hangers and shaft connections. For exceedingly light work, celluloid punctured full of small holes is used for the sides of the barrel. For medium-sized work, wicker barrels or baskets are generally used, and these are cylindrical in shape if the articles require a heavy deposit which must stand extra buffing or polishing, but where it is desired to impart a preliminary polish to the articles to be plated, the baskets are octagonal in shape. For heavy work, such as stove parts or other individual pieces of large cross section and considerable weight, barrels of wood are used. Some of the larger outfits have a capacity of 500 pounds of work per batch.



General View of Plating Vat with Side Cut Away, Showing Rotating Cathode Element and Elliptical Anode.

There is not a solution except gold which has not been successfully worked with these electro-mechanical plating devices, and there seems to be no valid reason why, for small articles requiring a coloring coat of gold, an apparatus of this kind could not be used. Galvanizing small articles, such as nuts, bolts, washers, etc., that require a protecting coat of zinc, is done exceptionally well.

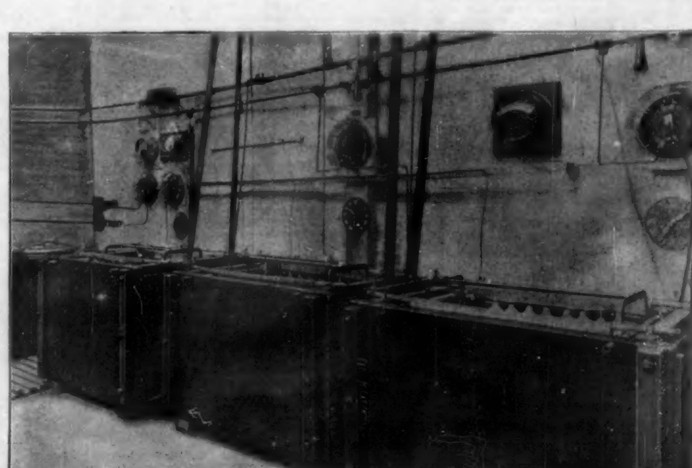
The barrel dimensions are 4 inches by 24 inches. The capacity is 50 to 70 pounds, according to the individual weight of the pieces, but the outfits are made in all sizes up to barrels 2 feet in diameter and 48 inches long, the latter having a capacity of about 500 pounds.

With the advances made in nickel plating during the past few years, the tendency has been to use larger containers, which naturally require anodes of increased dimensions. To meet this condition properly, various schemes have been tried, one of these being the crowding of a large number of plates into the tanks or using irregular shapes, sometimes with cumbersome attachments.

These experiments have led to the use of anodes having elliptical cross sections, and as a further improvement these are curved at the free ends, as shown in one of the illustrations. These curved elliptical anodes virtually surround the barrel or basket, and hence are equidistant at all times from the work, while their peculiar shape and relatively small cross section permit a much more even distribution of the metal and a better circulation of the solution.

It has been demonstrated beyond question that with a wide anode, say 5 inches or more, a corresponding cathode or piece of work that is in the process of plating will receive a much less deposit opposite the center of the anode than at its edges. This has been absolutely confirmed by a careful micrometric measurement of the deposit. By the use of the new elliptical anode, which is not over 2½ inches wide and of sufficient thickness to cause an equal distribution of the metal in every direction, all of the surface required is readily obtainable, and a full and complete circulation is also effected around each plate.

With the apparatus under consideration, two speeds are provided, the high speed being used where the articles to be plated are without sharp edges and can be tumbled very rapidly when a preliminary finish is imparted. With a great many articles it is unnecessary to buff them. This method of plating should commend itself to progressive manufacturers, since its merit as a labor saver has been conclusively demonstrated.



Plating Room, Showing Battery of Electro-Mechanical Plating Vats.

A MECHANICAL ELECTRO-PLATING APPARATUS.

Halley and His Comet.

When a young man of twenty-one Halley left England for St. Helena, and there, in the years 1676-1678, he laid the foundations of stellar astronomy for the Southern Hemisphere; moreover, in the course of his work he there succeeded in securing the first complete observation of a transit of Mercury. After his return to England, the next few years of his life were spent in laying science under a special debt that can hardly be over-appreciated. He placed himself in personal relation with Newton, propounded to him questions and offered information; and it is now a commonplace statement that Halley's questions and suggestions caused Newton to write the "Principia." More than this, we know that Newton's great treatise saw the light only through Halley's persuasive insistence, through his unwearying diligence in saving Newton all cares and trouble and even pecuniary expense, and through his absolutely self-sacrificing devotion to what he made an unwavering duty at that epoch in his life. Again, he appears to have been the first organizer of a scientific expedition, as distinct from a journey of discovery, toward the Southern Seas; he sailed as far as the fifty-second degree of southern latitude, devised the principle of the sextant in the course of his voyaging, and, as a result of the voyage, he produced a General Chart of the Atlantic Ocean, with special reference to the deviation of the compass. Original, touched with genius, cheery of soul, strenuous in thought and generous by nature, he spent his life in a continuously productive devotion to astronomical science, from boyhood to a span of years far beyond that which satisfied the Psalmist's broodings.

New Method of Pouring Small Objects in Rotating Element Prior to Plating.

Halley's close concern with Newton's "Principia" made him the Mahomet of the new dispensation of the astronomical universe, and he was prepared to view all its phenomena in the light of that dispensation. A comet had appeared in 1682—it was still the age when scientific men could think that, by a collision between the earth and a comet, "this most beautiful order of things would be entirely destroyed and reduced to its ancient chaos"; but this fear was taken as a "by-the-bye," which happily interfered with neither observations nor calculations. Observations had duly been made. The data were used to obtain the elements of the orbit, employing Newton's theory as a working hypothesis; and he expresses an incidental regret as to the intrinsic errors of assumed numerical elements and of recorded observations. It then occurred to Halley to calculate similarly the elements of the comet which Kepler and others had seen in 1607, and of which records had been made; the Newtonian theory gave elements in close accord with those belonging to the comet calculated from the latest observations, though a new regret is expressed that the 1607 observations had not been made with more accuracy. On these results he committed himself (being then a man of forty-nine years of age) to a prophecy (which could not be checked for fifty-three years to come) that the comet would return about the end of the year 1758 or the beginning of the next succeeding year; he was willing to leave his conclusion "to be discussed by the care of posterity, after the truth is found out by the event." But not completely content with this stage of his work, he obtained with difficulty a book by Apian, giving an account of a comet seen in 1531 and recording a number of observations. Halley, constant to his faith in the Newtonian hypothesis, used that hypothesis to calculate the elements of the orbit of the Apian comet; once more regretting the uncertainty of the data and discounting a very grievous error committed by Apian himself, Halley concluded that the Apian comet of 1531, and the Kepler comet of 1607, and the observed comet of 1682 were one and the same. He confirmed his prediction as to the date of its return, and he concludes his argument with a blend of confidence and patriotism:

Old Method of Stringing Small Objects for the Plating Bath.

"Wherefore if according to what we have already said it should return again about the year 1758, candid posterity will not refuse to acknowledge that this was first discovered by an Englishman."

Such was Halley's prediction published in the year 1705. The comet pursued its course, and it was next seen on Christmas Day, 1758. Candid posterity, so far from refusing to acknowledge that the discovery was made by an Englishman, has linked Halley's name with the comet, possibly for all time.

The Carbonic Acid Pump.

The city of Hanover has in its fire service a carbonic acid pump working in connection with a steam pump. While the acid pump is actuated by a battery of storage cells the steam pump, which is on an automobile, is conducted to the locality of a fire by means of carbonic acid compressed in tanks. The charcoal briquettes are placed on the grate and watered with alcohol from a receptacle, where it is kept under pressure by carbonic acid. The water in the boiler is always kept at the temperature of 212 deg. F. by means of a small gas burner. —Nouvelles Scientifiques.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 8250.—For manufacturers of ice-making machinery.

Inquiry No. 8251.—For manufacturers of wood fiber and wood fiber products.

Inquiry No. 8252.—For manufacturers of charcoal burners for making charcoal out of refuse wood; also for makers of stump pullers.

Inquiry No. 8253.—For manufacturers of machinery for making pins for insulators on telephone and telegraph poles; also manufacturers of stationary and portable boilers and engines.

Inquiry No. 8254.—For manufacturers of electrical counter that will work on seven connections, and must count consecutive whether there is a current in one connection at one time, two, three or the seven at the same time.

Inquiry No. 8255.—For manufacturers of pressed zinc fruit jar covers.

Inquiry No. 8256.—For manufacturers of Edison's patent electric rat trap.

Inquiry No. 8257.—For manufacturers of relief copying machine; also address of firm selling Dedrick-Wyon relief copying machines.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

PEN HOLDING AND RELEASING DEVICE.—J. O. Dodge and H. E. Dodge, Williams, Ariz. Ter. This invention has reference to improvements in penholders, and has for its object the production of a penholder in which the pen can be quickly removed from the holder when desired without soiling the fingers, as is common to the ordinary penholder.

FLUE-STOPPER.—A. Piche, Sault Ste. Marie, Mich. In the present patent the invention has reference to means for closing stovepipe and other similar holes leading into smoke flues or chimneys and has for its object a novel, improved, and simplified device of the character stated commonly known as "flue-stoppers."

CATAMENIAL SACK.—Carrie M. Greenwald, New York, N. Y. This sack is economic, pliable, and well adapted for its purpose. The body is so constructed that the pad may be quickly, smoothly, and conveniently placed therein and as readily removed from the body and the pads are so constructed that they can be lengthened and shortened as desired. The invention further provides flat and durable terminals for the body for attachment to a belt or other form of supporter. The pads can be readily removed, and the device is sanitary.

ANVIL ATTACHMENT.—O. F. Heer and J. Gamber, Washington, Pa. Horseshoes are ordinarily blocked out at a factory, and when received by the blacksmith the blanks are without toe and heel calks or clips. The principal object of the inventors is to aid in the necessary operations in preparing the blank before it is put upon the foot and to conveniently associate with each other in an attachment to be applied to anvils means for performing the several operations necessary in preparing shoes for application to horses.

STOVE-HOOD.—J. G. Nichol and C. H. Carlson, Iron Mountain, Mich. In the present patent the invention has reference to means for arresting steam, gases, and fumes arising from cooking and other stoves and deflect the same through a suitable opening into the stove-uptake to be carried away with the smoke and combustion-gases from the stove.

Household Utilities.

HANGER.—I. Stanley, Lovington, Ill. Mr. Stanley's invention relates to window curtains and shades; and his object is to provide a new and improved hanger more especially designed for supporting the curtain-rod and the window-shade and arranged for convenient and secure attachment to the window frame. The brackets are very simple and durable in construction, can be cheaply manufactured and readily applied to the window-frame to support both a curtain-pole and a window-shade.

BED-BOTTOM.—G. Beranger and J. A. Stewart, Halifax, Nova Scotia, Canada. One of the principal objects of the invention is to provide a bed-bottom embodying all the characteristics or qualities of a mattress and which is capable of being rendered practically self-conforming to the lines and curves of the body of a person recumbent in any position—that is to say, the lines and curves of those portions brought into direct contact with the supporting-surface of the structure.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending July 17, 1906.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Hook and eye, H. Atkinson ... 826,134
Horseshoe, F. B. Gardner ... 826,419, 826,420
Hose coupling, I. R. Concoff ... 826,018
Hose coupling retaining means, metallic, R. B. Painton ... 826,353
Hot air furnace, C. E. Oldacre ... 826,441
Hot water distributing apparatus, E. Boulboulle ... 826,468
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Walls and ceilings, means for molding, G. De Paolis 826,057
Washing and disintegrating apparatus, W. A. Koneman 826,174
Washing machine, J. H. & T. Schoregge 825,939
Watch, stop, J. Petrillo 826,444
Water closet bowl, A. W. Howe 826,335
Water closet tank, C. A. Miller 825,921
Weighing machine, E. Cameron 826,141
Weighing machine, W. S. Scales 826,475
Well drilling cable, J. Reid 826,063
Wheel. See Gear wheel.
Winding arbor, collapsible tape, A. L. Adams 825,951
Winding arbors, handle for, Winslow & Owen 826,002
Window dresser, G. F. Hall 826,160
Window or like screen, C. C. Armstrong .. 825,952
Window screen, adjustable sliding, J. C. Stefner 826,384
Wire cutting machine, Smurr & Kamen 825,942
Wire straightening and cutting machine, G. W. Wood 826,077
Wire stretcher, J. T. Wright 826,006
Wood grinder, J. Morawe 825,925
Woodworking machinery, cutter guard for, G. B. Bartholomew 826,465
Wrench, A. H. De Groff 826,153
Wrench, C. C. Bull 826,401

DESIGNS.

Trunk lock, M. N. Drucker 38,129

LABELS

"California Olive Bitters," for medicine, W. H. Lewis 13,007
"Cemo Wall Finish," for a wall finish, W. Church 13,005
"Heart of the Cream of Cedar," for louse exterminator, G. W. Gallant & Son 13,008
"Nerv-o-rine," for a cure for drunkenness and delirium tremens, W. A. Gustofson .. 13,006
"Perfection Rectal Dilators," for dilators, Oriental Remedy Co. 13,010
"Sapolin Gold Powder," for gold powders, Gerstendorfer Bros. 13,004
"'Sapolin' Silver Aluminum Powder," for silver aluminum powder, Gerstendorfer Bros. 13,003
"Tape Register," for tape registers, American Coin Register Co. 13,000

PRINTS.

"A Committee of Three, The Anticipation," for a beverage, F. B. Nehus 1,723
"A Committee of Three, The Ejaculation," for a beverage, F. B. Nehus 1,725
"A Committee of Three, The Investigation," for a beverage, F. B. Nehus 1,721
"A Committee of Three, The Realization," for a beverage, F. B. Nehus 1,724
"A Committee of Three, The Temptation," for a beverage, F. B. Nehus 1,722
"Amount of Energy $5.00 Will Buy," for flour, L. P. Hubbard 1,729
"California Root Beer," for root beer extract, California Root Beer Co. 1,726
"Prince George," for cigars, American Cigar Co. 1,720
"Security Gall Cure," for gall cure, F. B. Dennie 1,728
"The New Diagnostic Light," for lights, E. M. Rosenbluth 1,731
"The 'So-Easy' Eye Glass," for eye glasses, Julius King Optical Co. 1,730
"Victor Infants Relief," for medicine, Victor Remedies Co. 1,727

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

PROPOSALS.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 10 o'clock A. M., August 7, 1906, and publicly opened immediately thereafter, for the construction of buildings consisting of operating house, power house, oil house, privy, etc., and erection of masts at the wireless telegraph station to be located at Fire Island Beach, Lighthouse Reservation, Long Island, N. Y. Applications for proposals should refer to Schedule 54. Copies of drawings can be obtained upon application to the equipment officer, navy yard, New York. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the Bureau.
H. T. B. HARRIS, Paymaster-General, U. S. N. 7-13-06.

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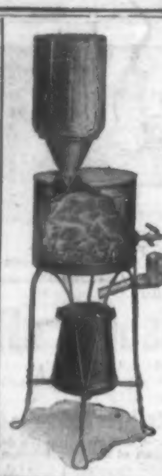

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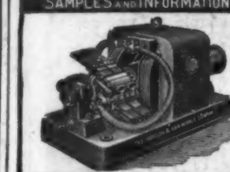

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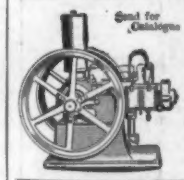

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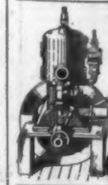

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